MANUAL FOR COMMANDERS

OF

INFANTRY PLATOONS

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The following Manual for Commanders of Infantry Platoons is published for the information of all concerned.

By order of the Secretary of War:

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TABLE OF CONTENTS.

PART I. PRINCIPLES OF COMMAND.

Page.

Chapter I. The commanding officer—Advice to a young officer 9
II. General rôle of the different grades in the company 15
III. Seniority—Right of command 17

PART II. ELEMENTARY TRAINING OF INFANTRYMEN.

Chapter I. School of the soldier (omitted).
II. Bayonet fighting (omitted).
III. Instruction in small arms firing (omitted).
IV. School of the grenadier 19
V. Formation and movements of the platoon (omitted).
VI. Formation and movements of the company (omitted).
VII. The company on the march (omitted).
VIII. School of the sapper 29

PART III. MATERIAL.

Chapter I. The rifle (omitted).
II. The automatic rifle 67
III. Machine guns 72
IV. Grenades 76
V. The 37-mm. (1.5-inch) gun 88
VI. Explosives and demolitions 91
VII. Tools (omitted).
VIII. Vehicles and animals in the field (omitted).
IX. Signaling apparatus 103

Page.

Chapter X. The telephone 112
XI. Means of observation and reconnaissance 116
XII. Low-power trench weapons 133
XIII. Various material for use in trench work and in the assault 140
XIV. Material for protection against gas attacks 144
XV. Effect of projectiles 148
XVI. Information on the field gun 155

PART IV. VARIOUS INFORMATION NECESSARY FOR A PLATOON COMMANDER.

Chapter I. General principles 157
II. Principles of organization 158
III. Infantry tactics 165
IV. Rifle fire—Fire against aircraft 166
V. Tactical employment of various weapons 171
VI. Principles of field fortification 192
VII. Notes on tactics of different arms and on staff duties 257
VIII. Preparation of orders and reports 266
IX. Methods of liaison and signaling 269
X. Hygiene and feeding 288
XI. Supply of munitions and material 301
XII. Railway transportation 311
XIII. Notes on the service of the rear 313
XIV. Notes on the laws of war 314

PART V. GENERAL DISCIPLINE.

Chapter I. Notes for the commander 316
II. The postal service 319
III. Punishments 321
IV. Courts-martial 322
V. Police powers of the camp commander 325
VI. Right of requisition 328

PART VI. INFANTRY IN CANTONMENTS.

Page.

Chapter I. Preparation of a cantonment—Bivouac..... 333
II. Interior service of the company in the field..... 339
III. Service of security in cantonment..... 343
IV. Honors to the colors..... 347

PART VII. INFANTRY IN THE TRENCHES.

Chapter I. A position in readiness..... 348
II. Infantry attacked in its trenches..... 370

PART VIII. INFANTRY IN THE ATTACK OF A POSITION.

Chapter I. Characteristics of the infantry combat..... 381
II. Combat of the platoon..... 392
III. Combat of the company..... 397
IV. Liaison during the combat..... 412

PART IX. THE PURSUIT AND MANEUVER WARFARE.

Chapter I. Security on the march..... 419
II. Security in position..... 423

PART X. METHODS OF INSTRUCTION.

Chapter I. Instruction in cantonments and behind the lines. 432
II. Instruction in instruction camps and depots..... 450

MANUAL FOR COMMANDERS OF INFANTRY PLATOONS.

PART I.

PRINCIPLES OF COMMAND.

CHAPTER I.

THE COMMANDING OFFICER—ADVICE TO A YOUNG OFFICER.

THE COMMANDING OFFICER.

The action of the commanding officer has a decisive influence on the morale of the command.

The commanding officer should be well trained, be an example to his men, and really "command" them.

Instruction.—The lack of knowledge in one who should create confidence among the men is a misfortune, for it causes timidity. The commanding officer "who knows his business" demands only useful efforts from his men; he does not use them prematurely or expose them to useless loss in battle.

The example.—Any organization is the reflection of its commanding officer. It is the most severe judge of him; it pays attention to his lightest word and observes all his actions. It only asks to be able to admire him and to follow him blindly. The best reward of a commanding officer is the fine behavior of his command under fire.

To command.—The commanding officer leads his organization because he knows how to be the most ardent man in it; but he

is also its master, because he always knows how to keep cool and to use good judgment. Nothing should be hidden from him and the command should give him its entire confidence. *To command* does not consist in merely giving orders. *To command* is to *give an order* and to *see that it is executed.* It also consists in being constantly on the alert; in keeping informed of everything that is going on around him; in originating orders if none are received, or in taking the initiative; in giving the necessary instructions at the proper time; and in keeping his inferiors constantly informed of existing conditions.

The authority of a commanding officer makes itself apparent first of all by the discipline of his command—execution of orders, bearing, outward signs of respect, cleanliness, good condition of arms, and correctness at drill.

In battle a disciplined command fights well, but undisciplined troops escape from their chiefs, throw away their arms, surrender, or run away.

ADVICE TO A YOUNG OFFICER.

Influence.—A commanding officer should impress himself on his command by his superior qualities. There is no single type of commander which young officers can take as a model, but each one should reflect and try to determine what natural or acquired qualities give to the best commanders of his acquaintance their influence over their commands. An officer recently promoted should not be content with thinking that he has been made a commander simply to secure obedience under ordinary daily circumstances. That would only indicate that his rank is respected. He should not be satisfied until he has patiently gained the confidence and the heart of his men; until he is certain that they have given themselves absolutely to him, and that they will obey him even to the death.

A young commander should remember that in critical times the authority that emanates solely from his own personality will always be far more efficacious than that which comes from the regulations.

Moral qualities.—A commander raises himself in the esteem of his men above all by the qualities of his character, and rightly so, for energy, initiative, will power, perseverance,

precision, judgment, self-control, sense of duty, and self-denial are qualities without which the finest gifts of intelligence remain of no value.

Among the qualities of mind, a general and extended military education is not produced in the course of a campaign; but every officer can and should possess himself of a thorough knowledge of everything that concerns his duties. If he has precise knowledge, he has confidence in himself, proper decisions will come readily to his mind, he will express himself calmly and without hesitation, and he will command the attention of the men; on the contrary, inappropriate or contradictory orders, given in an uncertain or nervous manner, inspire doubt as to their efficiency. The French soldier obeys blindly only when he has a blind confidence.

A commander is loved by his soldiers when he has a sense of justice, an absolute uprightness, is concerned with their well-being and pays personal attention to it. The soldier submits readily to all severities for which there is a reason, and, in his heart, he gives to excessive indulgence and weakness the consideration which they deserve. Justice does not consist in treating all men exactly alike, but in exacting from each the full exercise of his faculties and powers, and in rewarding meritorious actions in accordance with the efforts which they have cost.

The habitual attitude of the officer is also of importance; lack of dignity in bearing and language, vulgarity, and familiarity are never proper for an officer; everyone can be correct, simple, and dignified without holding his inferiors at a distance, and without preventing good humor and gayety, which, like hope and absolute faith in victory, are so readily and so happily imparted to others.

During bad days, when the men are discouraged, the officers and noncommissioned officers form the foundation on which the spirit of the company is rebuilt; they remember that "no matter what comes, one must never despair"; that there is no good reason why the enemy is not as badly decimated and depressed as our own troops; that in war, Dame Fortune has astonishing rewards for those who do not give up; and that complete victory belongs to him who is able to hold out a quarter of an hour longer than the other.

The spirit of precision—The importance of details.—In addition to those moral qualities necessary at all times, it is important that the young officer go deeply into the new requirements of war, which, at the present time, depend so largely on scientific qualities.

To-day every attack, every stubborn resistance, risks failure if the force engaged has not prepared its ground, its matériel, and its personnel with a minuteness superior to that of the enemy. In this preparation, where every detail is important, the least neglect must be paid for in the end.

The noncommissioned officers and the chief of platoon of infantry should realize that no matter how brave they are personally, their task will not be accomplished if they do not constantly apply themselves to the details which no other officer can attend to for them. Order, method, mechanical precision, and horror of the terms "almost" and "unfinished" have become essential qualities, the absence of which will surely expose a commander to the most serious disappointments.

Orders received and the initiative.—Command is exercised in accordance with the following principle: The superior determines the object to be attained, indicates his intentions, and defines the tasks to be executed by the subordinate elements; he leaves to the latter the choice of means for their execution. Officers and noncommissioned officers should make good use of that *initiative* in choosing the best means leading to the desired end.

Initiative does not consist, as is sometimes thought, in the right to modify an order that has been received, when it is thought that the result obtained will be better; such action is disobedience.

However, a noncommissioned officer should act on his own initiative:

First. To complete and develop an order when intentionally or otherwise the commander who has given it to him is silent on certain measures of detail which it is intended to be left to his judgment.

Second. When, for any reason, an order is not received and a decision is necessary. In this case he must give an order and report his action. He may be mistaken as to the urgency of the case, but the commander will always consider that "the only

faults which merit reproach are those of *inaction* and *fear of responsibility*."

Finally, in *very exceptional* cases, for example, when the situation is entirely changed between the time when an order was issued and the time it was received, initiative may lead one to act in an entirely or partly different way from that ordered; it is necessary then to be absolutely certain that "in disobeying the *text* of the order the *intention* of the commander is carried out," and a report of the action taken must be made without delay.

In all other cases discipline demands that orders be obeyed promptly to the smallest details which the commander has thought necessary to mention. Initiative is only exercised in regard to those details which have not been mentioned, and action on these should be in accordance with what is known of the commander's intentions and manner of thought.

Orders given.—The principal quality of an order is clearness. In war, *misunderstanding* is a more dangerous enemy than lack of discipline; more frequently than otherwise it destroys the strict execution of orders.

A subaltern officer often has the advantage of being able to explain and comment on the orders which he gives his men; their intelligence is thus brought into play, and they are more willing to carry out orders of which they understand the necessity.

But it is also necessary that the command understands that this is only done for the best interests of the service. It should be none the less ready to execute strictly, without hesitation or question, an order given without explanation. That is the very basis of discipline, and one can not revert to it too often, even if only as an exercise.

Frequently the orders of a noncommissioned officer are not properly obeyed because he gives orders to a lot of men collectively when only a few are required to do the work; each man then looks to his neighbor to carry out the order. The one giving the order should always divide the work up and assign it by name to the men who are to execute it. It seldom happens that a man who has personally received a clear and positive order will disobey it, but he will often try to evade an ambiguous order. Before formulating an order one must be sure that it can be carried out and is not capable of evasion; it must

say exactly what is desired and no more; the system of demanding more than is desired in order to be sure to have enough must be avoided. Whatever is ordered must be obtained; the difficulty is to properly estimate what is reasonable and profitable.

When a precise and correct order has been given, an immediate and severe penalty should follow its nonexecution.

It is not admissable for an officer or noncommissioned officer to fail to pay attention to a flagrant fault that he sees committed, under the pretext that the guilty person is not under his direct orders. This frequently happens, either through indolence or through fear of wounding the sensibilities of the commander of the man at fault. A noncommissioned officer is the superior of all persons in the military service who are of inferior rank. He should realize his authority and not make himself an accomplice of a man who misconducts himself in his presence. He should intervene tactfully and firmly and insist that the orders and regulations be carried out at all times and in all places. All slackness in camp and in the trenches arises from the failure to observe this principle.

In the company the noncommissioned officers should be the mainstays of their squads or sections, and they should never refuse advice to a man who asks it, or a solution of a difficulty which he brings before them. An excellent means of having little to repress in the interior management of the company is to lay down the principle that a man is never at fault when he is covered by the previous approval of a noncommissioned officer, but that he is always to blame when he has not referred to him if he has any doubt as to what he should do. On the other hand, a noncommissioned officer will be considered as unfit to command if he avoids accepting his responsibility of giving a direct reply.

Therefore the young officers and noncommissioned officers should never forget that they hold a part of the principle of authority, and that it has been confided to them with the understanding that they will not allow it to suffer under any circumstances.

Relations of officers among themselves.—Officers of the same company mess together; meal hours are hours of relaxation during which it is proper that they become sociable, but whatever

the familiarity that exists then, the deference due to experience, age, and rank must never be forgotten.

The respect shown by the lieutenant to his captain, his attention and punctuality in observing all his instructions, will be quickly observed by the command and will teach it obedience and military spirit by the best method—example.

CHAPTER II.

GENERAL RÔLE OF THE DIFFERENT GRADES IN THE COMPANY.

The company.—The company is the organization which appeals most to the soldier. It is the largest unit in which all the grades and men can be personally acquainted. It is the smallest one that can be charged with elementary tactical operation.

It has its own number, and its customs; it differs from its neighboring company. Also the captain is the real commander of his men; he is the confidant of their troubles as well as the compulsory intermediary of their requests. Nothing that concerns them is done without his advice. He has, in a way, a universal rôle, which there is no need of further defining here. He is responsible for every one in the company, and consequently has entire charge of all his subordinates.

The chief of platoon.—The chief of platoon is purely a military chief; he is the head of the strongest unit that can be controlled by the voice and kept in view when deployed. The platoon is the elementary group in battle; it engages, fires, and fights as a unit; it always acts as if its power was concentrated under a single head—that of the chief of platoon. The rôle of the latter is therefore most important.

Having under his orders only 50 men whom he never leaves, the chief of platoon is the only officer who can know in detail the character and aptitude of each one, and he is best qualified to judge of their daily morale and of the tactical situation, which he should always keep in mind (security, liaisons, observation, damage done to the enemy, etc.). On account of his other duties, he should require that the noncommissioned

officers give him full support so that he may maintain his moral and tactical rôle.

The sergeant commanding a half platoon.—The sergeant is, in practice, the first noncommissioned officer who has considerable authority, and, besides, he commands a sufficiently small number of men so that he can remember or note all the details concerning them—clothing, equipment, armament, supplies, etc. This is his rôle. His many duties can be expressed in the following words: To do whatever is necessary in order that the personnel and matériel of his half platoon shall always be present and in good condition. In a well-disciplined half platoon the officers need only make several daily inspections and do not have to do the work of the sergeant.

In battle the sergeant commanding a section has an important rôle, that of file closer. His superiors must speak to him often; tell him that fear is contagious; that the safety of the country requires that any weakness or the beginning of any confusion must be immediately suppressed; that to hesitate to kill a coward is perhaps to preserve 20 enemies or to cause the death of 20 comrades.

In the advance the sergeant does not put himself in the firing line, but sees that all the others are there.

In order that he may perform his duties in the most energetic manner it is necessary to give him much greater authority in the field than in peace time.

The corporal.—The corporal lives intimately with his men; he is their mess chief and justice of the peace.

The best corporal is the one who always has hot soup and food for his squad under all circumstances. The sergeant should not delegate to him any part of the permanent responsibilities which he should assume himself. The proper employment of a corporal consists in confiding to him the execution of successive and well-outlined tasks. From the grade of corporal those men who have shown the best qualifications for command are chosen as sergeants.

Selection of specialists in the companies.—The qualities to be looked for in selecting specialists are:

Clerks: Well ordered and accurate mind; discretion.

Liaison agents: Absolute devotion; legible writing; aptitude for making comprehensive reports; memory of terrain.

Observers and lookouts: Good sight; coolness.
Signalmen: Good sight; memory.
Riflemen: Vigor; daring.
Grenadiers: Aptitude for sports.
Stretcher bearers: Physical strength.

It is difficult to pick out specialists without diminishing the efficiency of the rest of the section. This great inconvenience will be lessened by the chiefs of platoons training or having trained numerous substitutes and observing that none of those on special duty who remain under their authority lose the qualities and fitness of the men in ranks.

CHAPTER III.

SENIORITY—RIGHT OF COMMAND.

It is important that the relative seniority of the sergeants, corporals, and first-class privates be always definitely fixed, so that, if the case arises, there will never be any hesitation on the part of the one who should automatically take command and become responsible.

The lists of seniority by rank should be made up, and the newly arrived informed.

The rule is that when two or more military persons assemble for service there is always one who is in command, the highest in rank, or if of equal grade the one of longest service; the lieutenant will thus establish the order of rank among the men of his platoon.

But in battle, when the lower noncommissioned officers have disappeared, it is necessary to take from the ranks the bravest private, and one who is not necessarily the senior. He leads the others; he is the commander.

It is necessary to impress this on the command: If the rules of seniority are correct in ordinary life, during battle they cease to exist among soldiers.

In the same grade, officers with permanent rank take command over those with temporary rank.

Between officers of the active army and officers of the new complement, of the same grade, seniority is established as follows:

Both count as active service, as regards their right to command, the time they have actually served with the colors in their present grade since the date of mobilization; those who have previously served in the active army with their present rank are credited with the seniority they had in that grade at the time they left the army.

In the same grade and with the same date of seniority, officers of the active army take command over officers of the new complement.

Seniority between sergeants and corporals of the active army is fixed in the same manner.

Exception to the rule of seniority.—The authority which orders the formation of a detachment can designate its commander, provided that no one in the military service is placed under the orders of a person of inferior rank.

"Command," properly speaking (command of a detachment, encampment, etc.), never belongs to officers who are of a corps or personnel which has a "hierarchy" of its own, even though such officers have assimilated rank (that is, medical officers, officers of administration, subintendants, etc.).

However, these officers have certain powers resulting from their special regulations, for example, a surgeon in his infirmary or in his dressing station.

PART II.

ELEMENTARY TRAINING OF INFANTRYMEN.

CHAPTER IV.

SCHOOL OF THE GRENADIER.

INDIVIDUAL INSTRUCTION—INSTRUCTION OF THE GRENADIER—INSTRUCTION OF THE SQUAD.

INDIVIDUAL INSTRUCTION.

1. Individual instruction is given to all soldiers without exception.

It includes exercises in throwing grenades and also theoretical instruction concerning the manufacture, dismounting, and manipulation of grenades.

Throwing.—The "throwing of grenades" is the basis of the instruction of the grenadier.

Accuracy in throwing is of the greatest importance, for besides the advantage it gives in battle it diminishes the risk of accidents and wasting of grenades.

The moral effect of a grenade bursting in a trench is added to its destructive effect.

The grenade should never be thrown scraping the ground or with the elbow bent. *The fire should be plunging.*

The normal method of throwing the grenade is as indicated in figures 10, 11, 12, 13, 14, and 15. This method will be modified according to the different positions from which the grenade is thrown (kneeling, lying down, from behind an obstacle).

Exercises in grenade throwing.—The men are first exercised in throwing dummy grenades over open ground and at known distances. Trenches are represented by tracing two lines on the

ground 1 yard apart, and placed at distances of 20, 25, 30 35 yards, etc. (Fig. 16.)

The "throwers" place themselves in trench A. They are exercised in throwing their grenades into trench B. They then increase the range successively to reach C, D, etc.

FIG. 10.—Pulling out the catch fuse.

The squads may be divided in half, one at the firing point and the other at the target. The second party returns the grenades to the first, and so on. Loss of time is thus avoided and the interest of all is increased.

Direction and accuracy can be developed by the employment of targets traced on the ground.

The men should be exercised in throwing grenades from standing, kneeling, and lying-down positions.

When the prospective grenadiers have acquired sufficient accuracy they are exercised in throwing grenades from one trench

FIG. 11.—Look toward the objective with the arm extended and the grenade in the right hand.

into another, then in advancing along a trench and throwing grenades over traverses.

Dismounting grenades—Manipulation.—The object of this part of the instruction is to teach the soldiers the normal working of the weapon, the accidents that are liable to happen, the

dangers that arise in certain cases, for example, in the case of failure to explode and the precautions that are necessary in handling.

It is strictly forbidden to dismount charged grenades, or even ones that are inactive but with charged detonator.

FIG. 12.—With left arm held in the direction of the objective, bring the right arm to the rear.

Consequently, the instruction will be carried out exclusively with dummy grenades made especially for that purpose.

It is absolutely necessary to prepare an instruction trench. It will be sufficient to dig two elements of trenches provided with two traverses separated by an interval of fire at 20 yards apart.

Each time that a command is at rest or in reserve the instructor should immediately prepare an exercise ground. Sunken roads, slopes, natural obstacles that can be adapted to the work in a few hours will serve as shelter for throwing real grenades.

FIG. 13.—With left arm in same position, extend right arm to the rear. Turn your eyes on the grenade and make sure that it will not be interfered with during the throwing.

INSTRUCTION OF THE GRENADIER.

In addition to the common instruction given to all soldiers, the grenadier receives special instruction and undergoes a more complete training.

This instruction includes—

The making of explosive charges.
The construction of dummy grenades.
The utilization of enemy grenades and detonators.
The handling of low-power trench mortars.

FIG. 14.—Look again at the objective. Describe an arc of a circle in the vertical plane with the right arm.

The object of the special training of grenadiers is to make the throwers quick and confident in their direction, and the instructors capable of setting the example to their comrades and of organizing the grenade combat.

Grenadiers should be especially exercised in firing rifle grenades. Continually on the lookout and prompt to seize favorable opportunities, they will inflict appreciable losses on the enemy daily.

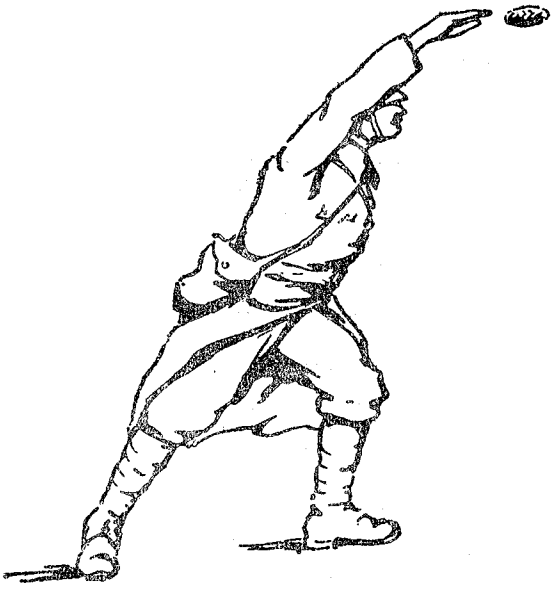


FIG. 15.—Throw the grenade, the right shoulder and the body following the movement of the right arm. The left arm follows the left shoulder, which is held back. The grenade will go in the direction in which the left arm pointed.

INSTRUCTION OF THE GRENADIER SQUAD.

The object of squad instruction is—

To teach any squad of grenadiers (particularly the first squad of each platoon) to prepare for grenade combat and to pass

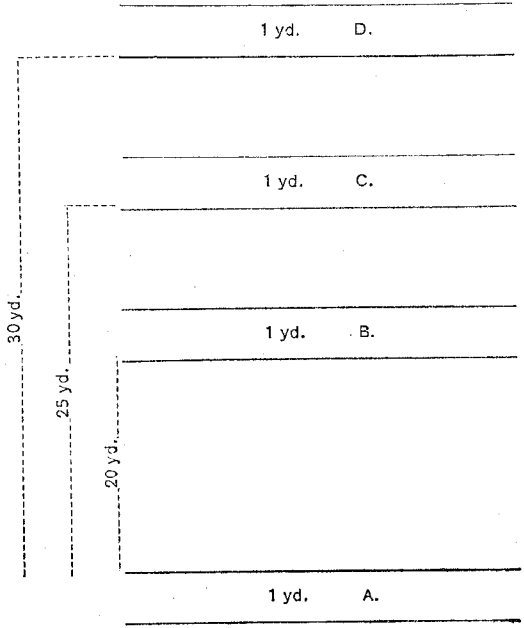


FIG. 16.

quickly to that mode of fighting whenever circumstances permit.

To teach the squad to effect a surprise attack with grenades.

As a rule, the men comprising a squad of grenadiers are divided for battle as follows:

Throwers.
Carriers.
Assistant grenadiers (formerly called riflemen).

Each grenadier being capable of immediately filling any one of these rôles upon being designated as thrower, carrier, or assistant.

The squad of 1 corporal and 7 grenadiers will then consist, under its squad leader, for example, of 2 throwers, 2 carriers, 2 assistants, and 1 spare grenadier. Or it may sometimes fight in two reliefs of 3 grenadiers each, one commanded by the corporal and the other by the most energetic grenadier.

More important groups will often be formed under the orders of a sergeant or a grenadier officer to carry a more extended point of resistance. Sometimes all the grenadiers of a company or a battalion will be grouped together.

The combat of such a group is the combination of the partial combats conducted by the groups of four or eight grenadiers, between which the grenadier officer has divided the whole objective, each being assigned to some carefully chosen point.

The instruction of the small squad is then the tactical basis of grenade combat.

RÔLE OF THE SQUAD LEADER.

The squad leader directs the combat; he distributes the men according to their qualifications, places them in the trenches or communicating trenches so that they will not be crowded, organizes the reliefs of throwers and carriers; he looks after the replenishment of grenades.

The squad leader seizes promptly every occasion to advance; if the advance becomes impossible, he prepares to defend the ground foot by foot, multiplying the barriers.

The grenadier officer, being in command of a much larger group, has two principal tasks:

First. To reconnoiter the objective; to distribute the squads or groups.

Second. To supply the squads.

This second task demands the greatest energy, discernment, and initiative.

RÔLE OF EACH SOLDIER IN A SQUAD FIGHTING WITH GRENADES.

Throwers.—The "throwers" should have their hands entirely free in order to manipulate the grenades without difficulty; they carry the rifle slung on the shoulder during combat.

For defense, they are provided in addition with a pistol and a trench knife.

The "throwers" will not always be able to carry the rifle when the fight is not to be followed up, as in the execution of a surprise attack.

Grenade carriers.—The "carriers" look after the replenishment of grenades. They replace the "throwers" if the latter are put out of action. They are armed alike.

Grenadier assistants.—The "assistants" should be chosen from among the most decided and alert men; they should be good shots and skillful in the use of the bayonet.

Their duty consists in looking after the security of the "throwers." They are sometimes called "scouts."

In a frontal attack over open ground they support the "throwers" and protect them with their fire.

In the communicating trenches they precede the "throwers" and pass around the traverses or bends, ready to stop any offensive return of the enemy. They endeavor to report the location of the fall of the grenades, to aid in correcting the fire, and signal to their squad leader the instant that advance is possible.

When further advance is impossible they notify their chief. Without waiting for orders a barrier of sand bags is thrown up as soon as possible and the "assistant grenadiers" take position to open fire.

In street fighting they watch especially the doors and windows.

FORMATION ON THE MARCH OF SQUADS DESIGNATED FOR COMBAT.

These squads usually advance in the same manner as patrols and reconnaissance parties.

The squad leader takes the place from which he can best control and direct his squad.

The "assistant grenadiers" are directed to reconnoiter the front and flanks and to protect the other grenadiers in case the enemy is encountered.

In crossing open ground the squads advance as skirmishers. The assistants are distributed in the line and are grouped particularly on the wings to support the grenadiers; in case of meeting the enemy the assistants reconnoitering the march rejoin the line.

In marching in the communicating trenches the squads form in single file in the following order: "Assistants," "throwers," "carriers."

SQUAD TRAINING.

Squad training is held on a prepared drill ground.

The command is taught to divide itself quickly into assistant grenadiers, throwers, and carriers, and they are instructed in the part that each of these should take under the different circumstances of combat, which are indicated later. (Book IV, Ch. V, 3°.)

The men should always work in complete silence, communicating as far as possible by gestures and signals.

It is much more important to have squads of grenadiers of average ability but trained to work together than to have a number of highly developed individuals. It is a great mistake to pay attention only to the individual instruction of the grenadier and to believe that the efficiency of the squad will follow naturally. Nothing is more difficult than to properly coordinate the action of the men in the same group, or of groups in the same combat.

CHAPTER VIII.

SCHOOL OF SAPPING—IMPORTANCE OF INTRENCHMENTS IN INSTRUCTION AND IN BATTLE.

Actual war has put tools in the same rank with guns.

To-day the soldier is both fighter and laborer; the one is no longer thought of apart from the other.

He makes use of his gun *sometimes*, of his tools at *all times*.

When he has gained an advantage at the price of blood, if he counts only on his gun to hold it, he will be cruelly deceived.

It is necessary, however fatigued he may be, that he attack the earth at once, that he know that every stroke of the pick is a check against the counter attack that the enemy is at this moment preparing against him.

For officers and noncommissioned officers to teach their men to shoot is relatively easy. *To get a company, fatigued and diminished by fighting, to set itself to work without rest is difficult.* It is, however, as imperative a duty as the first; the least offensive return can change success into failure, if the energy to conquer is not immediately succeeded by the energy of the pick and spade to hold the advantage won.

Officers and noncommissioned officers should facilitate the performance of this duty by inculcating in their men in advance the preceding ideas, ideas that are not always apparent to them; they should not lose an opportunity to communicate to them instances of engagements that illustrate the penalty of carelessness and the reward of tenacity in the matter of field intrenchments.

Two principles should enter into the minds of all:

1. *The construction of intrenchments ought never to be deferred under the pretext that the time necessary for its completion might be lacking.*

This principle is true in all situations, action or inaction.

2. *In combat, after an advance, the true relaxation of troops consists in laying out intrenchments for them and in imposing upon them immediately the work of constructing them.*

It is necessary that the surviving commanders have the energy to coordinate immediately every effort after the fight, *with a direct view to the operations that are to follow and to the preparation of the ground that they will necessitate.*

Otherwise, each soldier or little group will expend themselves in individual arrangements and improvisations; they dig, wherever they find them, holes and bits of trenches that are not useful for the resumption of the movement, and the battalion sometimes thus loses two or three days that might have been beneficially employed as indicated in the following paragraphs.

In order to thoroughly establish the second principle set forth above, it is necessary to prescribe that in instruction *every infantry maneuver should terminate in the laying out and construction of intrenchments on the last position attained.* Offi-

cers and enlisted men thus get the idea that maneuvers and intrenchments are one and the same thing, executed by identical commands and means. It is an error to classify maneuvers and intrenchments separately. Intrenchments are as much a part of the maneuver as are the deployment and the assault. And, whether offensive or defensive, there is no maneuver without intrenchments.

Classification of intrenchments in the manual.—The former regulations have been replaced by *Instruction in field fortification, approved December 21, 1915.* Every part of this instruction is of interest to officers and noncommissioned officers, who can not study it too much in detail. The length of the text alone prevents its entire presentation in this manual. The ideas that are extracted from it serve two different objects:

1. In Part II of the present work (Elementary infantry training) are indicated the essential elements of intrenchments that every soldier ought to know how to execute mechanically, exactly and without having to concern himself with the reason for their existence. This is the *manual of arms* for field fortification, and it is taught with the same rigor as in the case of offensive weapons.

2. In Chapter VI of Part IV (Principles of fortification) is treated the manner of putting at work these elements in an organization in conformity with a predetermined object.

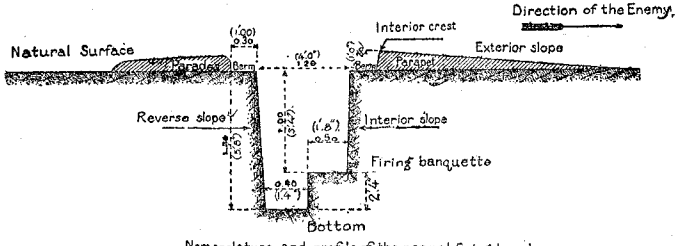
Normal types of field works.—In order to ground the education of infantry pioneers on a solid basis, there is given below but a single normal type of the following intrenchments:

1. Cover for a rifleman lying down.
2. Trench for rifleman standing.
3. Traverse.
4. Niche for ammunition.
5. Communicating trench, or approach.
6. Deep sap.
7. Russian sap.
8. Emplacement for machine gun.
9. Cave shelter (dugout).

Officers and noncommissioned officers should learn these fundamental types by heart, with their forms, dimensions, and the prescribed methods of construction.

The order to construct one of these types (communicating trench, emplacement, etc.), when it is accompanied by no modification, implies the exact construction of the normal type by the prescribed methods.

The men must be instructed in these normal types first of all. When they know them thoroughly it will then be easy to construct whatever type is taken from the Instruction in Field Fortifications, however modified by conditions of terrain, of materials, or by the time at one's disposal, etc.



Nomenclature and profile of the normal firing trench

FIG. 33.

Nomenclature of fire trenches and saps.—Excavations employed in field fortifications for firing or moving under shelter properly bear two distinct names, *dependent upon the manner in which they were made.* The name of *sap* is given to excavations executed by sappers, who advance foot by foot by extending one end of the excavation, and the name of *trench* is reserved for excavations dug simultaneously on more or less extended fronts.

In current language it has become customary to apply the term *trench* to firing trenches, *parallel* to communications located parallel to the front, and *approach* to such as are perpendicular to the front.

The words *sap* and *trench* nevertheless retain their value to indicate the method of construction employed. One can say, for instance, with precise meaning, an approach trench or an approach sap, a fire sap, etc.

Finally, among sap excavations there are distinguished:

The *sap proper*, now called approach, and in the digging of which the earth excavated is placed at the end of the excavation nearest the enemy.

The *deep sap*, which is an approach without parapets, from which the earth is carried to the rear as excavated.

The *deep covered sap* or *covered sap*, which is the same as the preceding but is hidden by a light layer of earth supported by wattling or poles.

The Russian sap, an underground passage without sheathing or casing, the roof of which is cut in the form of an arch at 10 or 12 inches below the surface of the ground.

The masked sap, a covered sap with a framework ceiling, proof against bullets and shell fragments.

The sand bag sap, when digging is not practicable, the two parapets being constructed of bags of earth piled 6 to 7 feet high.

It is improper to use the term *sap* to designate an underground work. Such works pertain to mining operations, and are known as *galleries* or *branches*.

It is important to observe these designations.

Qualities of a trench—Width.—There is better protection in a narrow trench, although movement and observation are easier in a wide one.

Depth.—A deep trench gives better protection but is more difficult to retake if the enemy captures it. It requires an elevated banquette, with special provision for rivetting this banquette and getting up on it.

Slopes.—Steep slopes do not stand so well but increase the security by diminishing the width. They permit the men to stand close to the parapet.

Relief.—If it is too slight, the view is impaired; if it is too elevated, the trench is visible from a distance.

Parapet.—A superior crest with a gentle slope, blending insensibly with the surface of the ground, lends itself to invisibility, especially if one can give it the appearance of the neighboring surface; avoid sharp changes of slope which are betrayed from a distance by the inequalities of the light.

NORMAL TYPES.

1. COVER FOR RIFLEMAN LYING DOWN.

Cover that riflemen try to make for themselves when they are under the necessity of covering themselves from fire.

FIG. 34.—Cover for rifleman lying down.

Riflemen, lying side by side, protect themselves at the beginning of the work by their packs; they dig the soil so as to form a bank of earth in front of them, working and firing as best they can.

2. STANDING TRENCH FOR RIFLEMAN.

The *standing trench* is the only one that, in modern combat, assures the soldier a sufficient protection and at the same time admits of the most efficient use of his weapons.

The profile and dimensions of the normal trench are indicated in figure 33.

The firing crest is 4 feet 4 inches above the banquette; the latter is 20 inches wide.

The bottom of the trench is 5 feet 8 inches from the natural surface of the ground, and 6 feet 8 inches from the top of the parapet.

The width of 4 feet at the surface of the ground admits of a batter to the walls.

The width is sufficient to accommodate temporarily two lines in the trench.

The elbow rests are uniformly 1 foot wide.

By stopping the excavation at 2 feet 4 inches from the surface, there results the *kneeling trench.* (Fig. 36.)

If there is also arranged a banquette 1 foot 4 inches high by 20 inches wide, a sitting trench is provided. (Fig. 37.) These two forms ought to be regarded only as steps in the construction of the standing trench, the latter being always the final objective of the work.

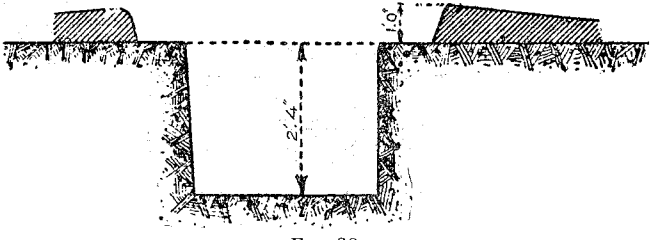


FIG. 36.

3. TRAVERSE.

Traverses are an inseparable part of the trench. Their purpose is to protect from oblique and enfilade fire and to localize the effect of bursting shells.

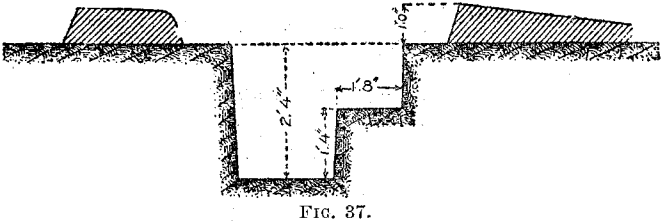


FIG. 37.

They facilitate furthermore the defense against an enemy who has gained a foothold in the trench. For this purpose these traverses should often be provided with loopholes.

Interval between traverses.—Eight yards is the maximum and 4 yards is the minimum between traverses.

Dimensions.—Traverses are made flush with the fire crest in order not to display a profile above it. In order to assure a sufficient protection, the *normal traverse* has a thickness of 8 feet at the natural surface of the ground and 9 feet at the bottom of the trench, so as to provide for batter. Its length will be 5 feet at the surface of the natural soil, so that the end of the traverse will extend beyond the rear line of the trench. (Fig. 38.)

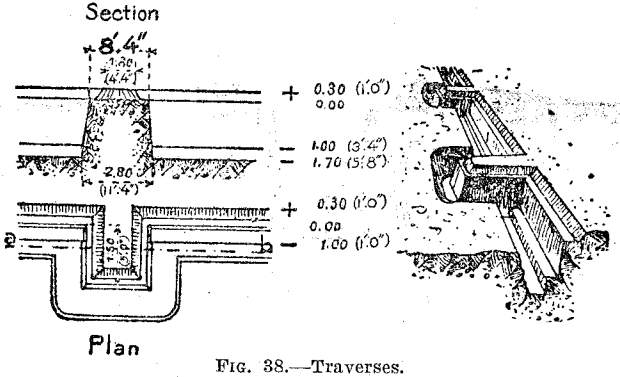


FIG. 38.—Traverses.

Traverses ought never to be hollowed out, and especially should never contain shelters.

NOTE.—If the trench has been constructed without traverses, the same purpose may be served by *splinter proofs*, arrangement having the exact thickness necessary to afford security from splinters without materially decreasing the length of the interior (fire) crest, and formed of fascines, sand bags, gabions (fig. 39 gabion splinter proof), or gravel tamped between the two plank walls.

The distinction between *traverses* and *splinter proofs* lies in their construction. The former are developed in the original soil at the time of the construction of the trench, while the latter are built in after the trench is completed.

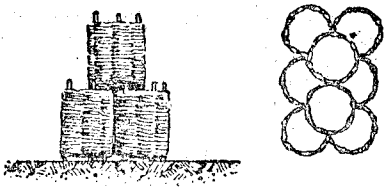


FIG. 39.

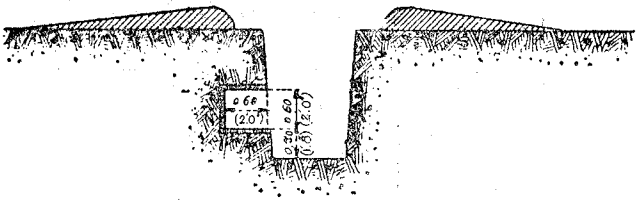


FIG. 42.—Ammunition nitch.

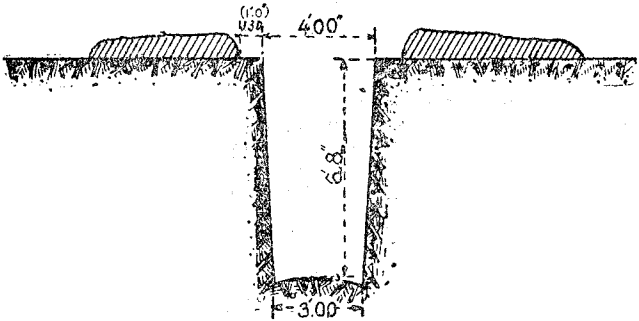


FIG. 43.—Communication trench.

The earth is carried toward the rear by assistants, by relays of shovelers (4 yards per relay), or by means of baskets and wheelbarrows (35 yards per wheelbarrow relay).

7. RUSSIAN SAP.

A gallery without sheathing, the top of which is cut in the form of an arch. (Fig. 45.) The earth is carried to the rear as in the case of the deep sap. Ventilation holes are arranged here and there, permitting the location of the arched roof in

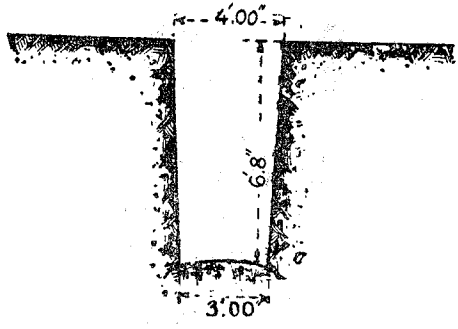


FIG. 44.—Deep sap.

relation to the surface of the earth as the work progresses. The execution is difficult, possible only in very tenacious soils. Advantages: Invisible advance toward the enemy; can be broken open at the last moment and converted into an approach or a trench the construction of which has been completely concealed.

8. EMPLACEMENT FOR MACHINE GUN.

The normal emplacement for a machine gun should be susceptible of very rapid construction without overhead cover in mobile warfare.

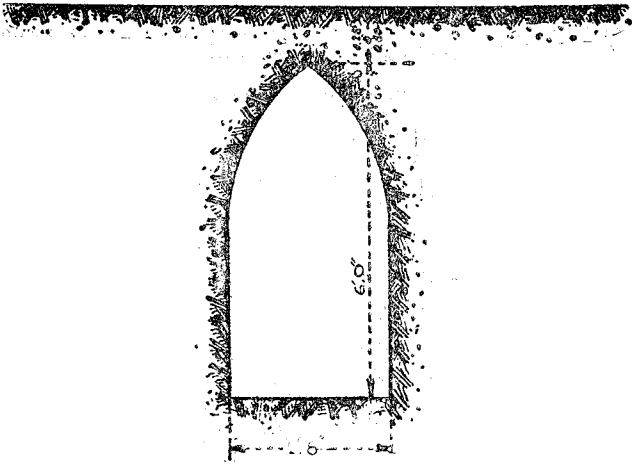


FIG. 45.

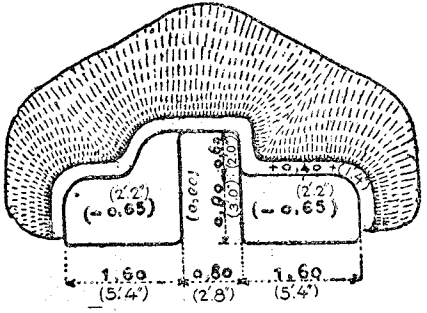
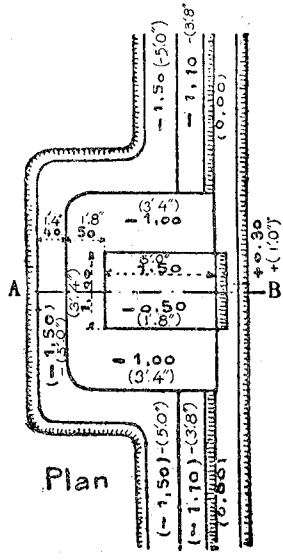
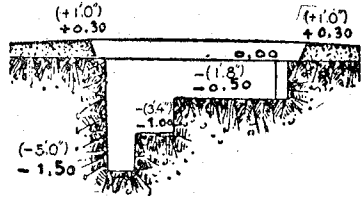


FIG. 46.—Emplacement for a machine gun fired from prone position.

The progress of aerial reconnaissance forbids its use on the parapet of trenches unless carefully disguised; this is an absolutely essential condition in its employment.





Cross section of figure 47.

FIG. 47.

Machine guns are generally installed outside of the trench, frequently concealed in a shell crater, to which access is obtained by a gallery.

The excavated earth should be displayed *near* or dumped *into* neighboring craters.

With these reservations, the emplacement indicated in figure 46 protects very well both the piece and those serving it in the

lying down position; in order to fire in the normal position the platform is lowered 1 foot and the depth of the trenches is carried down to 2 feet 8 inches (fig. 48).

It is essential that every emplacement prepared for a machine gun indicate clearly the *sector of fire* of this machine gun; this is accomplished by driving into the platform three stout stakes 2 or 3 inches in diameter and projecting about 4 inches so as to form a triangle. One of the pickets marks the

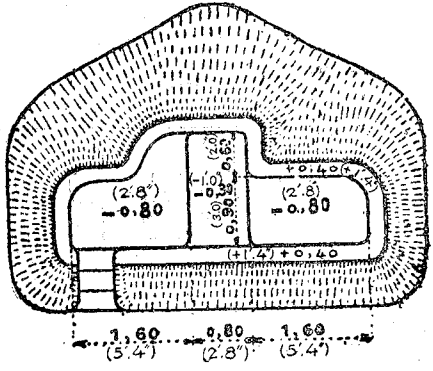


FIG. 48.—Emplacement for a machine gun fired at normal height.

vertex of the angle and the other two mark the sides of the angle within which the machine gun can and should fire. These stakes have nothing to do with locating the legs of the gun tripod, which would serve no purpose, but indicate by means that may be recognized even by groping in the dark if necessary the direction of the intended sector of fire and its extent. Reject every other means that is too fragile or that might not be understood without explanation by a new occupant.

9. CAVE SHELTER OR DUGOUTS.

There is no normal type of *overhead cover* either *light* or *reinforced.*

The models indicated in Chapter IV, Part IV, of this manual and in Instruction in Field Fortifications are only examples in which everything depends on circumstances.

A dugout is said to be "*proof*" if it can resist systematic fire from guns varying from 130 to 150 millimeters (5 to 6 inches), and isolated shots from 210 mm. (8 inches) and over.

"Proof" shelters without overhead cover (of which there will be given an example later on) are always inferior to *cave shelters*, which are to be preferred even if their construction consumes a little more time.

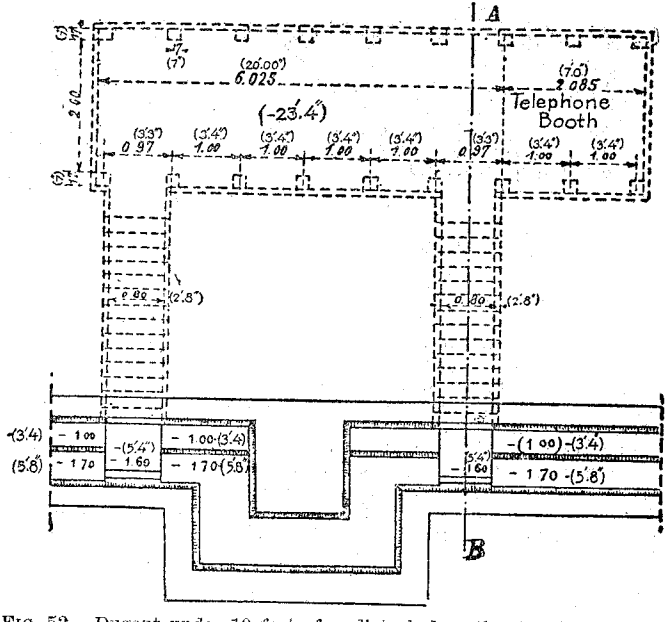


FIG. 52.—Dugout under 10 feet of undisturbed earth. Maximum depth to be executed 20 feet.

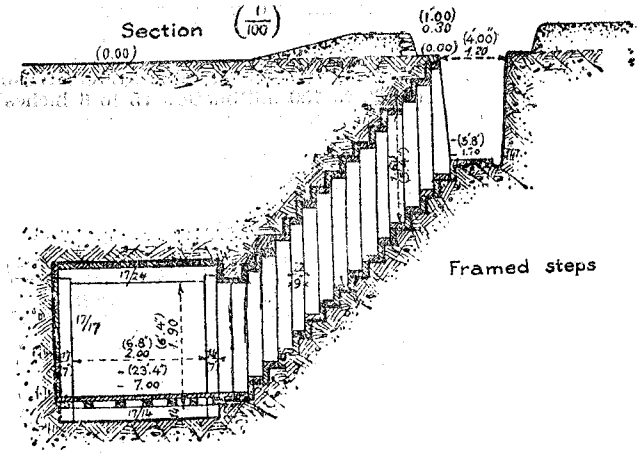


FIG. 52a.—Dugout under 10 feet of undisturbed earth. Maximum depth to be executed 20 feet.

The dugout is therefore, in the absence of some other controlling factor, the absolute rule. It ought to be undertaken *without delay* by the infantry itself, under the direction of the regimental and company pioneers, without awaiting the assistance of engineer troops. Every officer and noncommissioned officer ought to know in detail the simple normal type represented in figures 52 and 52a.

The characteristics of the normal dugout are:

1. They are located under at least 20 feet of undisturbed earth. Eighteen feet of hard compact chalk resists large mine shell and heavy shell with delayed action fuse. Figure 52 represents a shelter with only 10-foot cover; it is easy to imagine it deeper.

2. It has two entrances debouching on both sides of a traverse. These entrances are constructed either with *mine cases* or with *frames and sheeting* as half galleries.

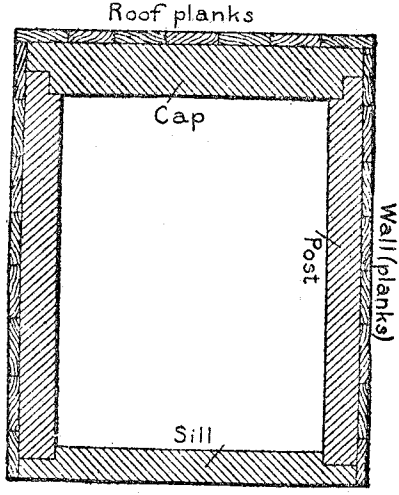


FIG. 52a.

3. It is advisable to have a third entrance opening on open ground in rear, possibly in a shell crater concealed or disguised, and that it communicate with neighboring shelter by a mining half gallery or a branch. (Fig. 52b.)

4. Entrances are united by a grand gallery capable of accommodating a section.

5. The shelter should be constructed with the greatest care: the *entire system must be rigid;* lateral bracing is indispensable. Any neglect will result in the crushing in of the woodwork.

Nomenclature of the cave shelter.—The *mine case* entrance is represented in figure 52; the half gallery in 52d. The *galleries* are composed of *frames, ceiling planks,* and *wall planks.* A *frame* is composed of a *cap,* two *uprights,* and a sill. (Fig. 52a.)

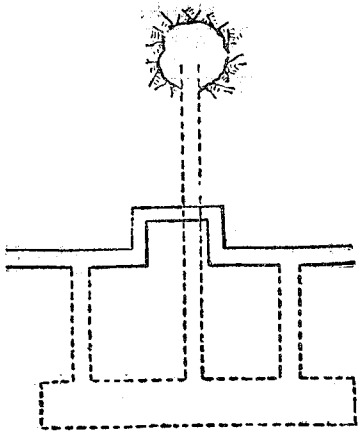


FIG. 52b.

The ceiling planks are thicker than those for the walls (about 1½ inches and 1 inch). The ordinary width is 8 inches.

The cap is always of the greater cross section and the sill of the smaller. It is necessary to guard against interchanging them.

Dimensions of frames ordinarily used by infantry.

Name of frame.	Dimensions.		Cross-section in inches.		Number of planks.	
	Height.	Width.	Uprights.	Cap.	Wall-casing.	Ceiling.
Half gallery.....	4½ to 5 feet..	3 feet 4 inches.	4x4	4x6	12-17	5-8
Common gallery.....	6 feet 8 inches.	3 feet 4 inches.	5x5	5x6	13-24	5-8
Grand gallery.....	6 feet 8 inches.	7 feet.....	7x7	7x9	16-24	8-12

The *half gallery* is used for the entrances only.

The *common gallery*, to shelter men seated or a row of men lying lengthwise.

The *grand gallery*, for men lying crosswise or two rows of men lying lengthwise with a passage in the middle.

The *branches* (large branch, small branch, fighting branch) and *shafts* are employed only by sappers in mining warfare.

Various recommendations.—When there are no squared timbers available, it will be necessary to substitute round ones of equal cross section.

In all construction the heaviest timbers must be used as *caps;* the caps can never be too strong. Uprights, being subjected only to longitudinal compression, may be of slightly smaller dimensions, if they are not too long; in an improvised frame they ought never to exceed 6 feet 8 inches.

Never omit the sill, and always sink it flush in order that it may not trip up anyone, unless a plank walk is laid on the sills.

Bracing.—Bracing is for the purpose of preventing the relative displacement of adjacent timbers and to secure the rigidity of the whole.

There are always two systems of bracing—one lateral and one longitudinal. In the particular case of a mine gallery, the object of the lateral bracing is to prevent the deformation of the

frame (fig. 52c) and the longitudinal bracing gives rigidity between successive frames (fig. 52d).

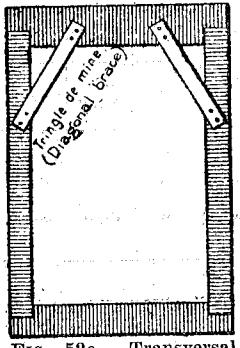


FIG. 52c.—Transversal brace of a chassis

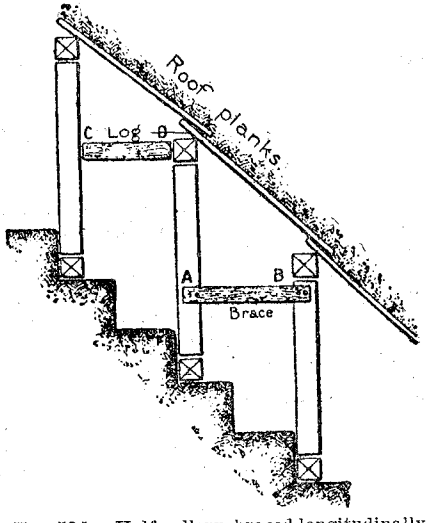


FIG. 52d.—Half gallery, braced longitudinally.

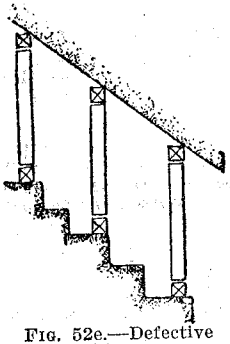


FIG. 52e.—Defective staircase.

This latter is secured by a heavy rib and strip nailed as in AB, or by a round timber securely wedged in as in CD.

Steps.—Steps should be arranged as shown in figure 52d, and not in the defective manner shown in figure 52e.

Tamping.—It is very important to tamp the earth well against the planks and not to leave any empty spaces between the earth walls and the sheeting. Such spaces may be detected by striking the walls with a stick.

NOTE.—Neither the dugout nor the entrances thereto should be termed "saps."

CONSTRUCTION OF A TRENCH.

Trace.—The officer in charge of the work traces on the ground the line of the exterior side of the excavation (tape, stones, stakes, furrow traced with a pick, etc.) and, if he fears some error, the inside border. He will use white tape whenever he can get it.

Assignment of tasks.—Taking into consideration the extent of the work, the character of the soil, the number of men and tools at his disposal, he determines the composition of the working parties and the length of the task of each. This length is, in general, about one pace per man in the working party. Each sergeant superintends several working parties. Corporals work as do other enlisted men, except those who act as sergeants. With park tools on ground easy to dig two shovels and one pick will be distributed to each working party of three or six men. The length of trench dug by each party will therefore be 3 or 6 paces.

In hard ground one pick and one shovel will be issued to a party of two men or four men, working on a front of 2 or 4 paces. When there are two men per tool as great efficiency may be secured as with one man per tool, although the task covers twice as many paces, if the tools are kept constantly at work and the men are made to work with increased vigor, since they rest half of the time.

The limit of each task is indicated in advance by lines drawn perpendicular to the trace. A sergeant divides the men into working parties and distributes the tools, behind the line. The working parties are then led in column of files or twos toward one or the other extremity of the trace, and then execute *on right or left into line*, or *front into line* of working parties, each party halting in line opposite its task and facing the enemy.

Absolute silence is preserved, and precipitate haste is avoided. The director of the work verifies the position of each working party and then commands in a low voice: *Remove equipments.* At this command each man removes his equipment and deposits it with his rifle 4 paces in rear, completes the tracing of the lateral limits of his task (by extending the furrow on both sides of the trench), and immediately begins digging. Men await their turn to work lying down in rear of the line of equipments.

Construction of a Sap.

Sap work is indicated below in the most minute detail in order that it may always be executed in the same manner.

It is forbidden to deviate in any particular from these methods, which are the result of a long experience and which secure the maximum rapidity of progress preceding an attack.

When men are left to themselves they generally work alternately with the pick and shovel, under the pretext that it is easier and quicker. When their officers constrain them to a rigid compliance with the prescribed method of work they rapidly acquire the habit and will really progress more rapidly.

The first operation consists in opening a sap head through the parapet of the trench of departure. This being accomplished, by one of the processes explained later, there is first established, 18 inches to the front, the head mask of shields or sandbags, closely packed together.

First Process: In the Immediate Presence of the Enemy.

SINGLE SAP.

Personnel and matériel.—Each sap head squad is composed of one noncommissioned officer and four sappers. The latter are divided into two reliefs, which relieve each other yard by yard, alternately working in the sap and resting in the trench. If necessary to continue the work day and night there will be required: One sergeant and 1 assistant, with 12 men, divided into three reliefs of 4 men each, each relief being eight hours on duty. If possible 1 extra man per sap head is provided.

In each working relief the men are numbered 1 and 2. They change numbers every work period, No. 1 becoming No. 2, and vice versa. No. 1 is equipped with a pick and a sort of short-handled hoe (made from a pick-shovel), and also a 4-foot measuring stick (the width of sap at the top) and one of 6 feet 8 inches (the depth of the sap). No. 2 has an ordinary shovel and a 1-foot measuring stick (the width of the berm).

The saphead squad should also be provided with the following: 1 long-handled wooden hoe, 1 ordinary long-handled iron hoe, 1 bundle of small stakes, 1 pick and 2 shovels in reserve, 1 short-handled park pick, 1 short-handled shovel or spade-shovel, 1 screen and some metal trellis for the rapid construction of defense against grenades, 1 supply of hand grenades.

Construction of the sap.—The sergeant (chief of sap) indicates by stakes the direction of the sap, and fixes with a measuring stick and stakes the task of the party. He posts his four sappers. He verifies frequently the dimensions of each stage of the work and notes the time taken by each relief in the execution of its task.

Sapper No. 1 (pick) works in front at the head of the sap. At first on his knees or crouching he attacks the earth over the entire width and at the final depth of the sap: 4 feet at the top, 3 feet at the bottom, 6 feet 8 inches deep below the natural surface. He digs first two grooves the depth of the pick-iron in the lower half of the sap in prolongation of the sides of the form, and then a horizontal groove of the same depth at the bottom of the trench, in order to mine and detach a block. He tears down the portion thus mined, commencing at the bottom. He successively drags the detached earth out between his legs by means of the short-handled hoe, being careful to clean the sap out thoroughly, so the full depth of 6 feet 8 inches will be maintained. Then standing erect he attacks the upper part of the trench, digging equal grooves on the right and left up to the surface of the soil, and then knocks down the head-block thus mined and outlined, and hoes the earth out between his legs as before. He thus advances the head from 16 inches to 20 inches or thereabouts, verifying the dimensions from time to time with the measuring sticks with which he is provided.

Sapper No. 2 (shoveler) follows immediately in rear of No. 1. He removes first with the short-handled shovel or spade-shovel,

then with the ordinary shovel, the earth dragged out by sapper No. 1, and heaps it in front to thicken the mask, then to the right and left to form parapets. The earth is thrown by No. 2 over the head of No. 1, or alternately to his right and left, onto the top of the parapet. He is careful to distribute the earth over the most advanced portion of the parapet in order to close the hole made in advancing the head mask, and over the mask itself in order to maintain it always at its normal dimensions. He arranges the berm of 1 foot between the parapet and the edge of the excavation, and he regulates this berm as necessary by means of the hoe.

Sappers Nos. 1 and 2 can change places at the middle of their task of 1 yard's advance.

Advance of the mask.—When the trench has reached the mask, sappers Nos. 1 and 2, assisted if necessary by the second relief, and also lying down as much as possible to avoid uncovering themselves, push the head mask about 1½ to 2 feet forward by means of the sap hoe, pushing the earth from below upward obliquely in the direction of the parapet or by throwing the sandbags onto the front part of the mask.

Sapper No. 1 engages the hoe against the earth of the mask and shoves on the handle. The other sappers also lay hold of the handle and together they shove it forward.

Changing reliefs.—At the signal "change," made by the leading sapper when his measuring stick indicates that the new trench has progressed 1 yard, the first relief lays aside its tools and is replaced by the second.

Second Method: In Immediate Proximity to the Enemy.

DOUBLE SAP.

Personnel.—Each sap head squad is composed of 1 noncommissioned officer and 8 sappers, divided into two reliefs. Continuous work requires 1 noncommissioned officer, an assistant, and 24 men in three parties of 8 men each, relieving each other every 8 hours.

In each party the sappers are numbered from one to four, Nos. 1 and 3 being pickers, and Nos. 2 and 4 shovelers.

Number 1 is provided with rules of 4 feet and 3 feet 4 inches, No. 3 with rules of 3 feet 4 inches, 6 feet 8 inches, and 1 foot.

Construction of the sap.—Pioneers 1 and 2, equipped with short-handled tools, work at the head of the sap according to the rules prescribed in the first method and construct a first form 4 feet wide at the top, 3 feet 4 inches wide at the bottom, and 3 feet 4 inches in depth below the surface, without troubling to arrange any berm between the parapet and the excavation.

Pioneers 3 and 4, equipped with ordinary pick and shovel, remain always at 3 yards from the head of the work. They deepen the first form to 6 feet 8 inches and throw the earth over the crest of the parapet, so as to increase the width of this parapet. Facing the parapet, they push the earth from below upward with the hoe, so as to make a regular berm 1 foot wide.

JUNCTION OF TRENCH AND SAP.

(*a*) *Uncovered.*—After having indicated by a stake the point of intersection of the new sap and the trench, the sap is driven through the parapet at right angles to the trench.

The earth of the trench parapet serves as a head mask during the crossing of the parapet, and all of the excavated earth should be thrown obliquely forward to form the parapets. As soon as the old parapet ceases to afford sufficient cover for the saphead, a portion of the earth is thrown forward to constitute a new mask, behind which the saphead continues its regular progress. It is inclined in its new direction on leaving the parapet.

(*b*) *Masked.*—The uncovered driving of a sap from a trench has the disadvantage of disclosing to the enemy the starting point of the sap and of making this point, when it is very near the enemy, the object of his showers of grenades.

The covered or masked sap is resorted to when it is practicable to make the arrangements for it at the time the trench is dug.

It is then sufficient to arrange on the ground in advance, at the selected spot, the necessary covering materials (boards, planks, railway ties, etc.) under which the sap will be driven.

The covering materials are at least 6 feet wide; they are carried and put in place by a special detail of workmen and are arranged on the ground at the moment the workmen are put in the trench.

These materials are arranged horizontally on the ground at night, parallel to the trench, ends together, and are immediately

covered with earth in order to conceal them from the attention of the enemy.

Construction of a Covered or Masked Sap.

Personnel and tools.—Each saphead squad is composed of:

1. Eight sappers directed by a sergeant and divided into two reliefs that change at every yard in the advance.

2. Enough helpers to insure the removal of the earth.

Sappers 1 and 2 of the working relief are each provided with a long-handled pick and a short-handled hoe; they have also a 6 foot 8 inch measuring stick (depth of the sap), one of 4 feet (width of the sap), and one of 1 yard (the length of task of each relief). Sappers 3 and 4 are each furnished an ordinary shovel, and they also have a long-handled hoe; the helpers are provided with the appliances made necessary by the method adopted in disposing of the earth.

Manner of execution.—Nos. 1 and 2 work alternately at the head of the sap and relieve each other as often as necessary. They make the excavation under the cover provided and in the given direction. The leading sapper first makes grooves on the right and left sides of the form from top to bottom, and then a groove across the bottom; when the earth tumbles down he hoes it to the rear between his legs; he is careful to clean the bottom out well in order to preserve the proper depth. Sappers 3 and 4, immediately behind the head sapper, haul the earth back rapidly with the long-handled hoe. This earth they then throw to relays of shovelers into boxes, baskets, wheelbarrows, or handbarrows, according to the method pursued. The task of each relief, which is 1 yard long, is measured from a stake that is planted in the left wall of the trench by the sergeant in charge as soon as the relief arrives. Numbers are changed with each relief's resumption of work, Nos. 1 and 2 becoming 3 and 4, and vice versa. The direction of the sap is marked by stakes driven in the bottom of the trench in such place as not to interfere with the removal of the earth.

Removal of earth.—The removal of the earth is effected by means of assistants established in reliefs as shovelers, or forming a chain for passing out the earth in baskets, etc.

SQUAD FOR FILLING SANDBAGS.

A squad for filling sandbags comprises two shovelers, one holder, two tiers, and as many pickers as the nature of the soil requires.

To fill a bag the holder kneels and holds the bag erect and open between the two shovelers, shaking it frequently to settle the earth, and when it is full he passes it to the two tiers who are behind him. A squad fills, on the average, 150 bags per hour.

The average sandbag properly filled weighs about 44 pounds. It should be of about the following dimensions: Erect, 20 inches high by 9 inches diameter; lying on the ground, 7 inches thick by 10 inches wide.

CONSTRUCTION OF A WIRE ENTANGLEMENT.

An entanglement with two rows of stakes

aA bB cC dD

a′A′ b′B′ c′C′ d′D′

may be regarded as made up of three panels,

First. The panel A B C D / a b c d

Second. The panel in the broken line AA′ BB′ CC′ DD′ / aa′ bb′ cc′ dd′

Third. The panel A′ B′ C′ D′ / a′ b′ c′ d′

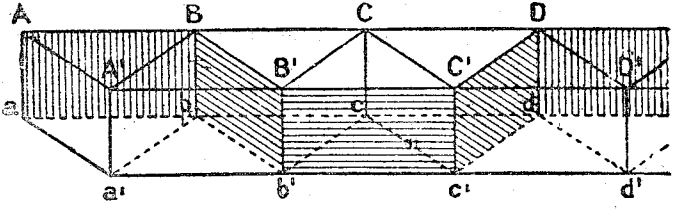


FIG. 53.

Each panel has four wires: One top wire, two diagonal wires, one bottom wire.

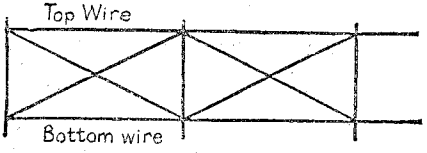


FIG. 54.

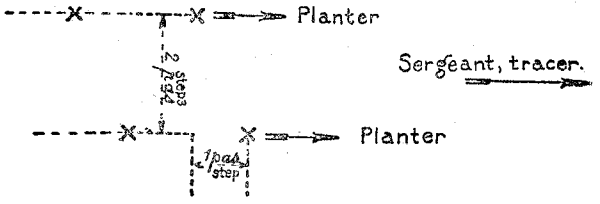


FIG. 55.

From the above is derived the methodical organization of the work.

1. *Tracing the entanglement.*—A sergeant or guide who knows the direction the entanglement is to take walks slowly toward the directing point which has been fixed in the night, followed by two stake drivers, who march on parallel paths with interval of about 2 paces, and echeloned so as to have about 1 pace distance.

These men at every 2 paces thrust lightly in the ground one of the stakes carried by helpers.

2. *Driving the stakes.*—The men are followed by two others carrying mauls. They are in turn accompanied by two assistants, whose duty it is to hold the stakes vertical and hold on top of the stake a pad or empty folded sack to deaden the sound while driving.

3. *Work of the wire squad.*—Each panel is composed of four wires, and two men are necessary to handle a roll of barbed wire.

Panel $\begin{matrix} A & B & C & D \\ a & b & c & d \end{matrix}$ (*the first panel*): The first squad attaches its wire to the foot of the first stake, takes a turn around the foot of the second, and similarly continues the advance. The second squad attaches its wire to the foot of the first stake, makes a secure turn around the top of the second, then carries it to the foot of the third, and so on. The third squad proceeds similarly to the second, *starting* at the *top* of the first stake. The fourth squad attaches its wire to the top of the first stake, takes a secure turn around the top of the second, and continues similarly. Eight men are thus necessary for stringing the wires.

For the *second panel* eight men are also necessary, as follows: One squad for the bottom wire, two squads for the two diagonals, one squad for the top wire .

For the *third panel* the same work and the same number of men, so for the three panels, *24 men.*

In all there will be necessary:

	Men.
1 sergeant, 1 guide	2
2 sledge men, 2 assistants	4
24 wire men (or reel men)	24
Total	30

4. *Supply men* (helpers).—The number of men necessary to supply the tracers with stakes will depend upon the distance that they must go in search of materials. One man can carry from three to five stakes, dependent upon their weight. Eight more men are necessary, two per panel, to supply the wire men with wire.

Observations on the foregoing.—All working parties go forward at the same time. Each man has a task, not difficult, to perform, and he can not make a mistake even in the dark. The spools of wire are used to the end without the necessity of cutting them. Although a considerable number of workmen (30) are put on the ground, this method offers little danger, for the squads are moving continually; and furthermore, in dangerous places, the parties can be dispersed as much as necessary, since the panels are constructed by successive independent operations.

Remark.—From the preceding it is easy to deduce the method of constructing an entanglement with any desired number of rows of stakes.

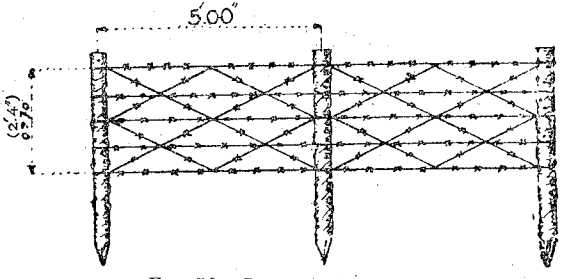


FIG. 56.—Improvised trellis.

Various uses of barbed wire or "Brun spiral."—Figures 56 and 60 show trellises or chevaux de frise that may be improvised from barbed wire or wire netting (the particular example is called "Brun spiral").

The dimensions given are variable.

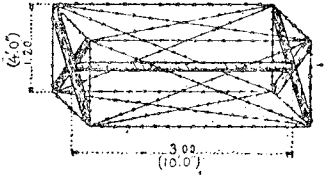


FIG. 57.—Saw-horse.

Brun spiral (invented by M. Brun).—Weight of a coil, 19 pounds. To place it, stretch it out to 30 yards to overcome its elasticity, then let it contract to 20 yards. Fix it to the ground by means of large staples (with equal branches) or hooks (un-

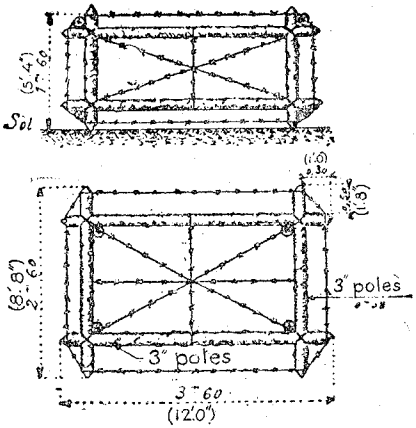


FIG. 58.—Large flattened cubes.

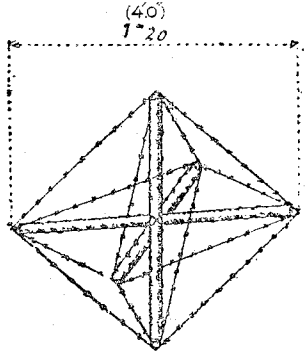


FIG. 59.—Hedgehog.

equal branches). If practicable, interlace with stakes. An excellent arrangement is to place two coils side by side and place a third on top of them, then binding the three securely

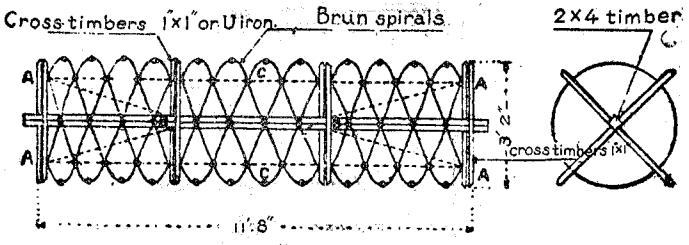


FIG. 60.—Brun spiral.

together with wire. The Brun spiral, of smooth wire, is at present almost entirely replaced by barbed-wire networks that have different names in different armies, and whose names also vary with the use made of them.

CONSTRUCTION OF FASCINES.

Troops that construct fascines should adhere rigorously to the dimensions prescribed, and remember that they are often required to be assembled like bricks in a wall; they must therefore be interchangeable.

Fascines are constructed of branches of trees or rods, pickets, and withes.

Rods.—Rods are obtained from the strongest and straightest poles that form the base of branches, or with strong withes, or with split wood. They are cut off at the small end to proper length.

Withes.—Withes are used in binding fascines, or to make the wickerwork of gabions or hurdles. They are selected from the smaller and most flexible branches, and trimmed of their branches and leaves.

Flexibility is increased by either of the following means:

I. Put the foot on the large end of the withe, twist progressively with the right hand beginning at the small end and holding the withe with the left hand. Pull the withe forward under the foot as the twisting progresses.

2. Place the small end of the withe in a cleft arranged in the end of a stake of 4 to 5 inches in diameter driven in the ground. Twist from the small end, holding the withe rigidly and winding it around the stake as the desired flexibility is attained.

The twisting being completed by one of these processes to within 8 inches or 12 inches from the large end, make, if practicable, a loop at the opposite end. One man should make 20 to 30 withes per hour. Wire of 0.09 inch diameter is used in place of withes for binding fascines, and of 0.06 inch for gabions and hurdles. Infantry should know how to make facines, gabions, and hurdles.

Construction of facines.—A *facine* (fig. 61) is a bundle of faggots 10 inches in diameter and 9 feet long; the weight varies from 35 to 44 pounds.

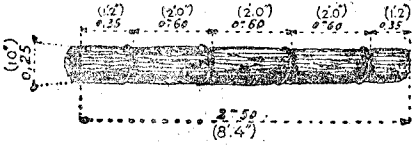


FIG. 61.—Fascine.

The rods are trimmed on a block of wood and assembled on a "horse" or between stakes, the larger and straighter ones outside. The faggot is bound by means of a "fascine choker" (consisting of a rope 3 feet 8 inches long, with loops at each end, and two stiff levers); the size is verified by a cord 25 inches long. The binding withes are then put in place, the choker being applied successively 2 inches from the position for each withe. The loop at the end of the withe is fastened as a slip knot; with the withe without loop, the ends are twisted to-

gether and turned under. The knots should be on the same line. Trim off all projecting ends of rods and branches.

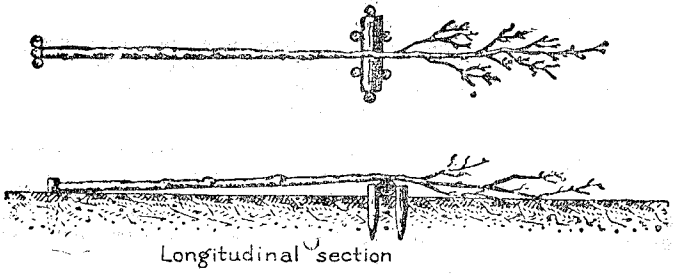


FIG. 62.—Block for trimming rods.

Construction of a gabion.—A *gabion* (fig. 65) is a cylindrical basket without a bottom, made of withes woven around vertical pickets. The weight of a gabion varies from 40 to 48 pounds.

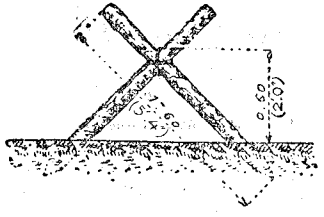


FIG. 63.—Horse for construction of fascines.

To construct a gabion, there are necessary 7 pickets and from 80 to 100 withes. Figure 66 indicates how the pickets are planted; they are inclined slightly inward. Two men place

themselves at opposite ends of a diameter and put in place two withes successively, interlacing them with the pickets and them-

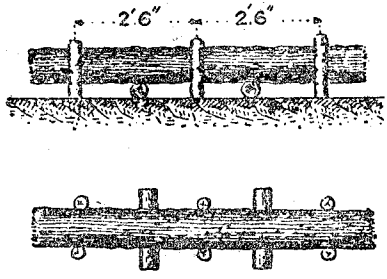


FIG. 64.—Construction of fascines between two rows of stakes.

selves as shown in the figure. The successive layers are compacted by hammering with a mallet. When the wattling is

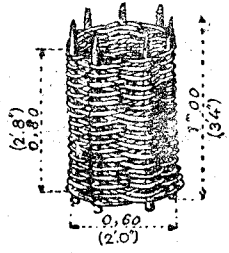


FIG. 65.

near the tops of the pickets, it is bound by four withes, each of which embraces a picket and five or six withes; then the

gabion is torn from the ground and reversed, the wattling is continued from the other end if necessary, and the final courses bound as described for the first end.

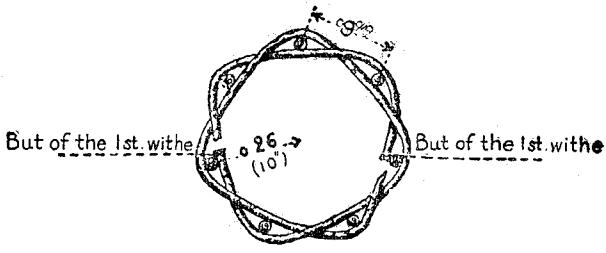


FIG. 66.—Large end of first withe; large end of second withe.

Trim the outside of the gabion, but leave the small branches on the interior.

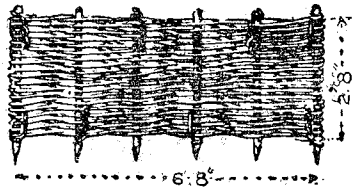


FIG. 67.

Construction of a hurdle.—A *hurdle* (fig. 67) is a wattling with a plane surface 6 feet 8 inches long by 2 feet 8 inches wide; its weight varies from 33 to 44 pounds.

To make a hurdle, there are necessary 6 pickets, and 80 to 100 wattling rods, and 8 withes. The pickets are planted in a

straight line and the operation is similar to that in the construction of a gabion. The small ends are cut off at the extremities of the hurdle, except five or six on each side that are twisted around the end pickets to bind the wattling. One withe is used to bind each corner, one at the end of each alternate interior picket at the top and the remaining two are used to bind to the other pickets at the bottom.

LIST OF DIMENSIONS TO BE MEMORIZED.

Heights of epaulement:
- Rifleman, kneeling, 3 feet 4 inches.
- Rifleman, standing, 4 feet 4 inches.
- Machine gun, lying down, 16 inches.
- Machine gun, normal, 2 feet 8 inches.
- Width of banquette, 20 inches.
- Width of excavation at surface, fire trench, parallel or approach, 4 feet.
- Bottom of fire trench, approach or parallel, without banquette, 3 feet.
- Berms, 1 foot.

Traverses:
- Thickness, 8 feet.
- Length (perpendicular to front), 5 feet.
- Average interval between traverses, 5 yards.
- Machine-gun platform, 5 feet by 20 inches.

Ammunition niche:
- Opening, 2 by 2 feet.
- Depth, 20 inches.

Cave shelter or dugout:
- Dimensions of half gallery casing (for descent), 5 feet 4 inches by 2 feet 8 inches by 9 inches.
- Inside dimensions of a half gallery, frame, 5 feet by 3 feet 4 inches.
- Inside dimensions of a common gallery frame, 6 feet 8 inches by 3 feet 4 inches.
- Inside dimensions of a grand gallery frame, 6 feet 8 inches by 7 feet.

Cave shelter or dugout—Continued.
Branch gallery connecting two shelters, 3 feet 4 inches by 3 feet 4 inches.
Fascine, 9 feet by 10 inches.
Gabion—
Diameter, 2 feet.
Length of pickets, 3 feet 4 inches.
Height of woven work, 2 feet 8 inches.
Hurdle:
Length, 6 feet 8 inches.
Height, same as that of gabion.

CONVENIENT MEASURES.

Rifle, with bayonet fixed, 5 feet.
Length of the bayonet or portable intrenching shovel, 1 foot 8 inches.
Width of blade of E. D. shovel, 8 inches.
Width of the hand, 4 inches.
NOTE.—The above will vary with different implements.

LIST OF THE PRINCIPAL TIMBERS FURNISHED BY SIEGE TRAINS.

1. BOARDS AND PLANKS.

Battens.—Thin boards, $\frac{1}{2}$ to $\frac{7}{8}$ inch; ordinarily they are $\frac{3}{4}$ inch.
Boards.—From $\frac{7}{8}$ to $1\frac{1}{2}$ inches thick; generally 1 inch, $1\frac{1}{4}$, or $1\frac{1}{2}$ inches.
Planks.—$2\frac{1}{2}$ inches thick by 8 to 10 inches wide; also planks 3 inches thick, sometimes thicker.
Heavy planks.—4 to $4\frac{1}{2}$ inches thick.

2. TIMBERS (SQUARED).

Rafters.—$2\frac{1}{2}$ by $2\frac{1}{2}$ inches or 3 by 3 inches square.
Balk (beams, girders).—Squared timbers thicker than the rafter.

Ribands.—Small pieces of timber 2 inches wide by 1 inch thick, ordinarily obtained by ripping up planks. Used in bracing mine casings. (See bracing of dugouts.)

Spars (round) are generally furnished in lengths of 3 to 4 yards.

Entanglement stakes.—5 feet 4 inches long and 2½ to 3 inches diameter.

Stakes for revetting trenches are generally furnished 8 feet 4 inches long.

PART III.

MATERIAL.

CHAPTER II.

THE AUTOMATIC RIFLE.

In this arm the reloading is automatically accomplished by the force of the recoil. Feeding is accomplished from semicircular packets (clips) each of which contains 20 DAM cartridges. A good adjustment of the extractor permits the use of the ordinary rifle cartridges (D) as well as the special machine-gun cartridges (DAM).

Personnel: One gunner, two ammunition carriers.

INFORMATION AS TO ARM AND EQUIPMENT.

(*a*) Gunner:

	Pounds.
Automatic rifle with case	20.02
2 clip pouches (4 clips)	8.80
Special pouch (4 clips and 1 cleaning outfit)	10.34
Automatic pistol, waistbelt, 3 clips	3.74
	42.90

(*b*) First ammunition carrier:

Special haversack (8 clips and 1 packet of cartridges)	23.98
Cartridge pouch (4 packets of cartridges)	17.82
Automatic pistol, belt, and 3 clips	3.74
	45.54

(*c*) Second ammunition carrier:

	Pounds.
Rifle 1886 and ordinary equipment (1 packet of cartridges in the boxes)	13.20
Ordinary haversack and 5 packets	29.04
	42.24

Each of the above carries also a haversack (for food), canteen, blanket, and tent canvas, one shovel pick at the belt.

Length of the arm	inches	41.3385
Length of barrel	do	17.7665
Weight of naked arm without clip	pounds	19.25
Weight of one clip	do	1.87

Cartridges carried:

By the gunner	160
By first ammunition carrier	480
By second ammunition carrier	384
	1,024

Summary of nomenclature.—The automatic rifle is divided into two parts: First, a *fixed part;* second, a *movable part.*

First. The fixed part comprises: (*a*) Guide sleeve; (*b*) stock; (*c*) firing mechanism; (*d*) bands, swivels, etc.

Second. The movable part includes: (*a*) Barrel, receiver and barrel recoil spring; (*b*) breechblock and breechblock recoil spring; (*c*) mechanism for feeding.

Information regarding "functioning."—To obtain the various operations necessary to the perfect "functioning" of the arm (extraction, ejection, reloading), it is necessary to secure automatically the separation of the *breechblock* and the *barrel.*

In the movements of these two parts, there are three phases to be considered:

First. Under the action of the gas: *The movable part, barrel and breechblock, is carried backward.*

The piece is cocked.

Second. Under the action of the barrel recoil spring: *The barrel returns to the firing position,* the breechblock is caught and held at the coupling.

Third. Under the action of the recoil spring of the breechblock: *The liberated breechblock is carried forward.*

To fire it is necessary to draw the breechblock to the rear, that is to say, *to cock it*, by means of the lug provided for that purpose, to snap the clip under the gun, then to press on the trigger in order to free the breechblock, which, being carried forward by the recoil spring, loads the arm and fires the cartridge.

The fire and safety lever has a *cam* that, according to its position, locks the piece, assures automatic fire, or fire by single shots.

For automatic fire: Cam horizontal (set at M), hold the finger on the trigger; if this action ceases the fire stops—barrel forward, breechblock caught in the rear position.

Endeavor to hold the line of sight on the objective; arrest the fire to repoint the piece.

Three kinds of fire: By short bursts, 2 or 3 cartridges (ranging fire). By long bursts, 6 to 8 cartridges (normal fire for effect). Rapid fire, 20 cartridges (in a crisis).

To fire by single shots.—Cam vertical and turned down (set at C). Press the trigger, and release it after having repointed the piece at each shot.

Safety.—Cam vertical and turned upward (set at S). The trigger mechanism is inoperative. The clip being exhausted, *cock* the piece; press the catch that holds the clip in place and receive it in the hand as it drops when the catch is released.

Accidents of fire.—The gunner can remedy on the battle field the following principal sources of arrest or delay of fire:

1. *Failure of the breechblock to "couple" (therefore to "cock") in the rear position.*—Draw the cocking piece (maneuver button) clear back so it will catch.

2. *Failure of barrel to return home.*—Work the maneuver button; if that does not suffice, strike the butt of the piece on the ground.

3. *Failure to extract.*—Extract the shell with the Hotchkiss hook or the cleaning rod that are in the pouch of cleaning materials.

4. *Failure to feed and faulty insertion of the cartridge.*—Do not waste time. Change the clip.

Care of the weapon.—Keep the piece in the case until it is required for firing (protection against mud, dust, etc.).

When firing.—Utilize every short suspension of fire to clean such parts as will not require dismounting the piece.

After firing.—Give special attention to *the bore of the piece, the chamber, the breechblock and the receiver, the clip and its spring.*

Current improvements—A flash and cover (to conceal flash).—A *detachable feed plate* permitting the use of the arm for single shot fired at the rate of 40 shots per minute when the clips are defective. A *sling* permitting the habitual carrying of the piece slung from the shoulder; carrying across and in front of the body in advancing as skirmishers; carrying under the right arm and firing while advancing.

Service of the automatic rifle—Position of the gunner.—The position of the gunner exercises an influence of the first importance in the proper functioning of the gun. Normal position, gunner lying down. The body is placed obliquely with respect to the axis of the piece, the *fore arms* serving as a support, the piece held by the right hand at the small of the stock (pistol-grip), the left hand at the balance. Place the right cheek in front of the bushing of the breech block in order to avoid the "kick". Facilitate the placing of the cheek by refusing the right shoulder and advancing the left shoulder. The line of sight will pass through the right eye when the body is so disposed with respect to the piece.

Observations on the position of the cheek.—The piece has three points of support: The crutch, the left fore arm, the right shoulder. Both hands exert continual pressure to bring the piece against the shoulder, to prevent getting off the target during long bursts of fire, and to avoid accidents.

Division of duties—Duties of the gunner.—Seeks objectives and estimates ranges, fixes the elevation, executes the firing and regulates its intensity.

Duties of the first ammunition carrier: Keeps at the right of the gunner to observe and secure the proper functioning of the piece, keeps the Hotchkiss hook in his hand, regulates the release of the loading piston of the clip, anticipates the exhaustion of the clip, observes the operation of the ejector, guards against accidents.

Duties of the second ammunition carrier: Serves as scout during the advance, fills empty clips at the firing point, main-

tains the supply of ammunition. Holds himself ready to intervene with fire or bayonet during the delicate moment of changing clips or in case of a jam.

To fire advancing.—The possibility of firing while advancing results in the delivery automatically of a low fire with a slight sweeping effect given almost naturally by the movement of walking.

This fire can be executed by single shots, by short bursts, by long bursts, or even by rapid fire of full clips in the unforseen contingencies of battle.

It is much easier when the piece is supported by a makeshift sling that passes over the left shoulder to the end of the barrel.

Position of the A. R. to fire advancing.—Grip the stock firmly under the right arm, seize the piece with the left hand at the balance, and press the left elbow against the body in such a way as to obtain a point of support there. The left hand should so grip the piece that the left arm acts as a firing support or trestle.

Rules for the advance.—Advance directly on the objective. Incline the body well forward and harmonize its movements with the firing of the piece. The cadenced step is convenient in firing by single shot. Each shot should be fired as the *left foot* strikes the ground.

A sufficiently rapid *flexion step* is suitable for automatic fire. The gunner and the piece should become a single mechanism, to such an extent that it is no longer the gunner who carries the gun, but is seemingly the gun that advances and the gunner who conforms to it with the movements of his body.

This result is arrived at only by daily training, comprising: Supplying exercises, progressive loading of the gunner, cross-country marches of gradually increasing difficulty, rushes from shell crater to shell crater, and finally the assault.

Practice the men in changing the clips while marching.

The maximum efficiency of the automatic rifle in battle necessitates, therefore, a thoroughly *instructed* and *trained* personnel. A thorough knowledge of this arm should be acquired not only by the gunners, but also by all officers and noncommissioned officers and the greatest possible number of privates. It is not admissible that the disappearance of a gunner should involve the cessation of fire from his gun; every weapon the operator

of which is placed hors de combat is at once seized and served by another; *the position of operator of an automatic rifle should be considered and sought as an honor.* (Called fusiliers in the Infantry.)

CHAPTER III.

MACHINE GUNS.

Machine guns in service: Machine gun, model 1907, remodeled (T.); Machine gun, Hotchkiss, model 1914.

Officers and noncommissioned officers should understand the manipulations essential to the firing of either of these models under critical circumstances. The following ideas will serve as an outline of the theories practiced, gun in hand, in evolving them. Every officer and noncommissioned officer should himself have fired one or two belts (of ammunition).

MACHINE GUN, MODEL 1907–T.

This machine gun has replaced the Puteaux gun and the M. 1907 not remodeled (N. T.).

The first utilized the force of the gas from the powder by the expansion of the gas at the muzzle.

The machine guns of 1907 N. T. and T. borrowed the gas on the way. They differed only in some minor details (motive power, sights, etc.).

They have two controls—

The *fixed trigger*, operated by the gunner, permits intermittent fire and suspension of fire.

The *movable trigger*, operated by the speed regulator through the intermediary of the trigger catch, permits automatic fire, with regulated cadences.

The *speed regulator* regulates the raising and lowering of the movable trigger. It becomes active when the *rapid-fire button* is pushed to the right; to vary the cadence, act on the *regulating lever;* it ceases to act when the button is pushed to the left.

Fire.—To put the machine gun in action—

1. *To load.*—Breechblock closed, insert a clip (belt) in the feed guide (cartridges underneath), for the metallic clip (up to the ratchet gear).

2. *To cock.*—Pull the *cocking lever* back to the catch. Open the breechblock. Carry the lever forward.

3. *To fire.*—(*a*) *Intermittent fire:* Press the trigger, release it immediately.

(*b*) *Cadenced automatic fire:* Place the speed-control lever at the division indicating the desired rapidity of fire, press the trigger, continue the action on the trigger.

(*c*) *Automatic fire with maximum rapidity of cadence.*—Push the rapid-fire button to the left, press the trigger, continue to press the trigger.

To arrest the fire.—Cease to press the trigger.

USE OF DIFFERENT FIRE AND CADENCES.

Locked fire.—Fire for adjustments or on a fixed objective of very narrow front.

Unlocked fire, without sweeping (Rare).—On very narrow objective.

Unlocked sweeping fire.—General; sweep always from left to right.

Slow cadence.—Rare; employed to adjust and to neutralize.

Medium cadence.—General; employed when not ordered to the contrary, 300 rounds per minute.

Rapid cadence.—Six hundred rounds per minute; objects fleeting, menacing, or compact.

Fire by reference stakes or marks.—Indirect fire; night firing.

To suspend or cease firing.—"Suspend firing": Release the trigger, lock, engage a clip. "Cease firing": Lock, remove the clip and breechblock, empty the carrier, inspect the chamber, uncock the piece.

Regulation of ejection.—Excessive ejection results in broken parts, and deficient ejection results in imperfect functioning.

Ejection is excessive when the shells are thrown more than 6 feet; feeble, when they are thrown less than 3 feet.

To regulate the force of ejection, turn the *graduated disk.* When the zero is at the index, the ejection is maximum. When the graduation 10 is at the index, the ejection is minimum.

Care.—Dismounting and care, and the means to be applied in case of jams, etc., are taught only to the machine-gun men.

Support.—The 1907–T uses either of the following supports: The tripod, model 1907–C, model 1907–omnibus, model 1915–omnibus; the rampart carriage, model 1907 and 1907–omnibus.

All of these carriages include a pivotal support and a tripod. The 1915 support is simpler and lighter than those of 1907.

Deflection: The pivoting support turns on a circular bed. It is immobilized for locked fire.

Elevation: By means of the elevating screw. Elevation limits are +20° and —25°. These limits may be extended by means of a movable device attached to the support.

The rampart carriage alone possesses a *sweeping* mechanism. In the other models sweeping is regulated by hand.

All carriages are provided with graduated sectors for laying the piece in deflection. A special leveling device permits laying in elevation.

All tripod supports admit of two heights of the piece above the ground: Standing, 32.67 inches; kneeling, 18.11 inches.

Ammunition.—The machine gun 1907–T fires the ordinary cartridge 1886–D. (bi-ogivale bullet of brass, powder, B. N. 3F.), but preferably the 1886 D. A. M., similar to the first, but with a special primer. It fires also the old cartridge, model 1886–M (cylindro-ogival bullet, with lead core and German silver sheath), but requires increased elevations (corresponding to an increase of range of one-third).

The cartridges are arranged in metallic strip clips of 25 cartridges each, or in flexible cloth bandoleers of 300 cartridges. The allotment is 10 of the latter per piece.

An ammunition box contains 12 metallic clips or 1 cloth bandoleer.

Boxes containing bandoleers have as distinctive mark, in addition to a red band, the letter H painted on the large face of the box, seen when the box is upright, cover hinge to the right. This serves the double purpose of distinguishing the top of the box when it is placed flat in the caisson, the base of the cartridges down, and for the convenient orientation of the box during fire.

Bandoleer boxes are inseparable from their bandoleers, and resupplying should be accomplished by changing boxes contain-

ing empty bandoleers for an equal number of boxes of full bandoleers.

Ammunition echelons:

1. With the combat echelon, 18 boxes per piece, 5,400 rounds.

2. In the C. Tn. of the M. G. Co., 3 caissons (or 24 pack mules), 25,000 rounds.

3. In the artillery park of the infantry division or corps artillery: Each small arms ammunition section has 13 caissons of machine-gun cartridges.

Transport.—Distinction is made between pack transport and cart transport. (See Organization of the Infantry Regiment, Part IV, Chap. II.) A cart can carry 1 M. G. complete, and from 6 to 12 boxes of ammunition. A pack animal carries 1 M. G. and 1 box, or 6 boxes.

	Pounds.
Weight of M. G	52.8
Tripod and support (model 1907)	72.6
Tripod and support (model 1915)	57.2
Box of ammunition	26.4
Total load of pack animal	264.0
Total load of a cart	792–836.0
Weight of a loaded caisson	4,180.0

(See "Ammunition supply," Part IV., Chap. XI.)

Hotchkiss Machine Gun, Model 1914.

Model 1914 is a modification of model 1900. The Hotchkiss utilizes gas in functioning the same as the 1907. It has a simple fire mechanism and has no speed control. It fires at the rate of about 450 rounds per minute.

Fire.—1. *To cock the piece:* Open the breechblock and pull the cocking piece clear back. Push it forward.

2. *To load:* Breechblock open. Insert a clip in the feed slot, cartridges uppermost, up to the ratchet.

3. *To fire:* (*a*) *Intermittent fire:* Press the trigger, releasing it quickly. (*b*) *Automatic fire:* Press the trigger, continuing the action.

4. *To arrest the fire:* Release the trigger.

Recoil control.—Excessive ejection is indicated by pronounced vibration and violent ejection of shells; deficient ejection, when the shells are not discharged freely.

Screw the regulator in or out in order to vary the capacity of the chamber. When set at 0 (zero) the ejection is at its maximum; at 4, minimum. The regulator is ordinarily set between 3 and 4 for mean temperature.

Support.—The Hotchkiss 1914 has one pivoting support and one tripod. Clear height: 27.56 inches to 13.78 inches. Elevation arc, 25° (+10 to −15). The supports of M. G. 1907 can be used by inserting a special cap.

Ammunition.—Same as model 1907. The use of cartridges 1886-D, which often have defective primers, should, however, be avoided. Metallic band clips of 24 cartridges or jointed steel bands or clips of 250 cartridges. Three jointed clips are issued per piece. Ammunition boxes contain 12 rigid or 1 jointed clip. Boxes are clearly distinguished by their shape. It makes no difference which side is up. Ammunition echelons, as for the 1907, to within a few hundred rounds.

Transport.—Hotchkiss sections are all carried in carts. The weights are similar to those for the 1907, given above.

MISCELLANEOUS INFORMATION.

Repairs.—For important repairs or exchange of pieces, the M. G. Co. applies directly to the *repair shop of the corps or division artillery park.*

It is there that cartridges are assembled in clips (bands); never in the company.

To disable the piece.—*M. G. 1907:* Take away the breechblock ratchet; bend the cover of the breechblock box and, if possible, break the hinge by hammering it backward, cover open.

Hotchkiss.—Remove the breechblock and the cover. Smash the feed elevator and the gas cylinder.

CHAPTER IV.

GRENADES.

Classification.—All grenades in use at the present time are provided with *time fuses* which cause explosion a certain number of seconds (average 5) after they are lighted.

Grenades for defensive action must be distinguished from *grenades for offensive action.* In combat at close quarters in

open terrain, and particularly during an assault, *offensive grenades* may be used without exposing the grenadier to danger from the fragments. The danger zone of these grenades is limited, extending not more than 8 to 10 yards beyond the bursting point. *Defensive grenades* burst in a shower of deadly fragments and are effectual at a distance of more than 110 yards from the point of explosion. They should never be thrown from a position unprotected from fragments which might fly back.

Grenades are thrown either by *hand* or *rifle*, the latter being thrown with the aid of a "discharger," a special device fitted to the rifle. Finally, there are *suffocating, smoke producing*, and *incendiary* grenades, for special uses.

Primers in use are as follows: *Metal primer* and *automatic primer, model 1916 B.* The second is intended to supersede the first.

The *metal primer* (see fig. 71) is a percussion primer. After removing the safety cap strike the grenade on the heel of the boot, rifle stock, or other hard object. This brings the primer into contact with the striker, thus igniting the slow match which in turn fires the detonator and causes the explosion. The safety cap prevents accidental puncture of the primer case before actual and intended use of the grenade.

A grenade must always be thrown immediately upon lighting and without stopping to verify its ignition.

The *automatic primer* (figs. 69b and 70) acts on a different principle. Two fuses are simultaneously struck by a percussion spring, in form of a small pincer, which is released by moving the bolt. This bolt is automatically moved by raising the lever, which is held in safety position by the pin (with ring) and, after the pin is withdrawn, by the hand holding lever and grenade.

To throw a grenade supplied with an automatic primer.—First. Hold the grenade in the hollow of the right hand, primer end up, the ring turned in and near the base of the thumb. The lever then lies in the palm of the hand and may be held firmly without effort. Second. By means of the ring withdraw the pin with the left hand (fig. 69a). The grenade is now set at "ready" and care must be taken to hold the lever down. Third.

Sight the target over the extended left arm and throw the grenade as prescribed in "Instruction for grenade fighting."

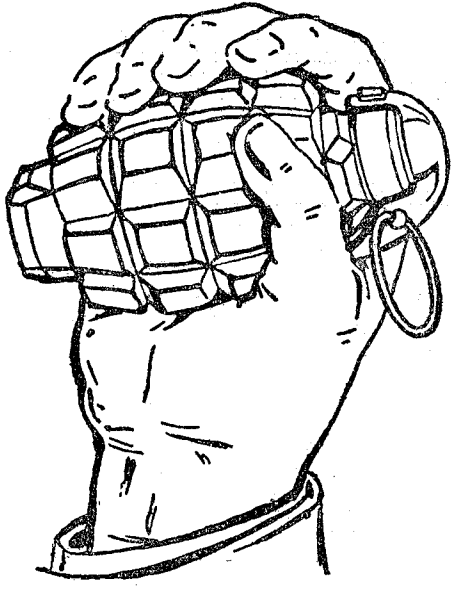


FIG. 69.

REMARKS.—Hold the grenade well up toward the primer so as to hold the lever firmly in position. Do not remove the pin until just before throwing the grenade. After removing the pin keep the hand closed but not clenched. The effort necessary to hold the lever down is slight, but must be continuous while the grenade is set at "ready."

It is forbidden to set off the fuse of a grenade before throwing under pretext that the match requires so long to burn.

The grenadier must avoid continuous holding of a grenade set at "ready," and must particularly avoid walking, as a false step might cause him to let it fall. Normally the raising of the end of the lever about 1 inch will cause the grenade to explode. In the process of manufacture this distance may be perceptibly reduced. Therefore, the hand should be kept tightly closed and no attempt made to test the working of the lever. The grenadier will soon learn that this weapon may be handled both safely and easily, provided he does not take chances.

Should the grenade fall, by accident, he must keep calm, pick it up quickly, and throw it before it explodes.

By developing the presence of mind in his grenadiers an instructor may avoid many accidents caused by carelessness. Each one should be required to practice throwing an empty grenade on the ground and then to count the seconds aloud. By the time he has counted 5 the grenade must have been picked up and thrown, and the entire personnel must be under cover.

PRECAUTIONS TO BE OBSERVED IN REGARD TO UNEXPLODED GRENADES.

Every unexploded grenade is a source of danger and should be regarded as a shell which has been primed, but not exploded. Therefore none should be left on the terrain. If proper precautions are taken and the grenade fuse has ignited properly, there can be no danger in picking up and throwing unexploded grenades. If troops are required to take a position where there are any unexploded grenades, these should be removed as soon as possible. One man, with the aid of a branch or stick, removes the grenades, while the rest of the personnel remain under cover. As a rule, failure to explode is due to nonignition of the fuse or the detonator; sometimes to an error in assembling the primer; and more rarely to failure of the percussion caps (or igniters) to operate. If the percussion bolt groove is not obstructed by mud, one can easily see if the fuses have operated, as the groove will be blackened. Such grenades are no more dangerous to handle than the ordinary grenade.

If, on the other hand, the sides and bottom of the groove are white and shiny, the fuses have not operated, and the percus-

sion spring, being in contact with the fuses, might ignite at any shock. In fact, by striking an unexploded dummy grenade violently, on any hard surface, the primer can be destroyed without striking the pin. This is due to the small mass of the striker. In any case, unless the operation of the fuses is quite evident, it is best to remove the grenades singly and by hand, without taking the eyes off them, so that they may, should they become ignited, be thrown away without delay. Unexploded grenades are piled together and fired by a petard. They may be used to advantage to charge a fougasse.

It is forbidden to unscrew the primer cap of a loaded grenade unless it is done with a special tool designed to protect the operator from the explosion.

If more than 6 per cent misfire, the fact should be reported and the mark on the body of the primer indicated.

GRENADES IN SERVICE.

The principal grenades are: (1) The *O F 1915* (offensive, fuse); (2) the *F 1915* (defensive, fuse); (3) the citron C F;

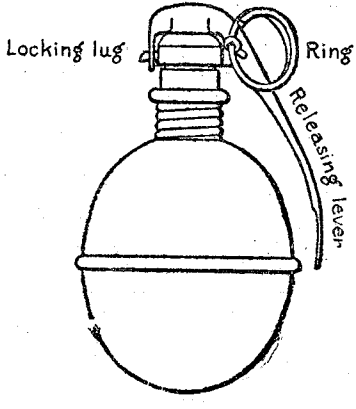


FIG. 70.—O F grenade with automatic primer.

(4) the *suffocating, model 1916;* (5) the *A B 1916* (incendiary, smoke producing, fuse); (6) the rifle *V B* (fuse); (7) the rifle *D R* (percussion).

First. Grenade O F 1915.—Fuse grenade, for offensive action. Composition metal, ovoid envelope 0.118 inch thick, filled with 5 ounces, 127 grains of cheddite. (Fig. 70.) Automatic or metal priming cap.

Shipment to the armies is made in cases containing either 200 loaded bodies or 50 priming caps. They can be *assembled* in any suitable place, after which the primed weapon may be issued to the troops. Total weight, about ½ pound.

Second. Grenade F, 1915.—Fuse grenade for defensive action. Cast iron, ovoid envelope, with exterior grooves to facilitate fragmentation. Either the metal or automatic primer may be mounted on this grenade. (Figs. 69b and 71.) Shipment to the armies is made in cases containing either 100 loaded bodies or 50 priming caps. They are loaded, primed, and assembled at Army depots before issuing to the troops. Charge 2 oz., 50.8 grains cheddite. Total weight, 1 lb., 5 oz., 70.5 grains.

Third. Citron C F.—Fuse grenade for defensive action. Simple variety of F1. Special percussion primer similar to the metal primer. This grenade can not be operated by an automatic primer.

Fourth. Suffocating grenade, Model 1916.—Fuse grenade. Leaded iron, ovoid body. Percussion primer. These devices are suffocating and tear producing, but little poisonous. They render inclosed or badly ventilated areas untenable and may be suitably used in forcing the enemy to evacuate shelters, caves, etc. The grenade, which has no explosive material except the detonator, may be safely thrown a distance of 15 yards in open country. Avoid throwing against the wind, as the suffocating gases would in that event be blown back to the thrower. Shipment to the armies is made in case of 25 grenades loaded and primed. Charge, 7 oz., 33.5 grains of special liquid. Weight, 14 oz., 47 grains each.

Fifth. Grenade A B, 1916.—Offensive, incendiary, smoke producing fuse grenade (74). Spherical, composition metal body, metal primer, and method of using the same as F. Does not

produce a dangerous explosion, but projects flaming particles within a radius of 15 to 20 yards. Should not be thrown against the wind, as the composition generates a dense smoke.

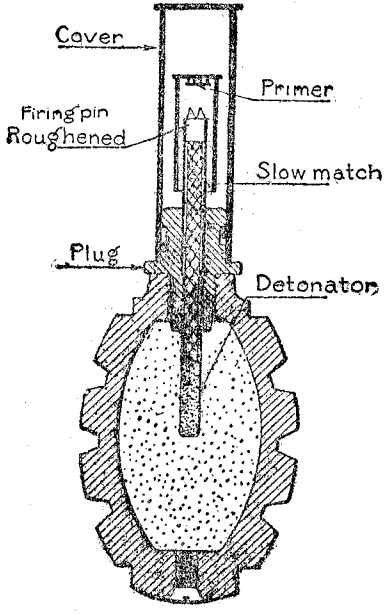


FIG. 71.—F_1 grenade with metal primer.

Twenty grenades will produce quite a thick cloud. An unexploded grenade of this type may be picked up and thrown again without danger to the user, after the primer has been changed.

Shipment to armies is made in cases of 50 grenades ready for use. Charge, 1 lb., 1 oz., 277.5 grains of inflammable composition. Total weight, 1 lb., 9 oz., 94.95 grains.

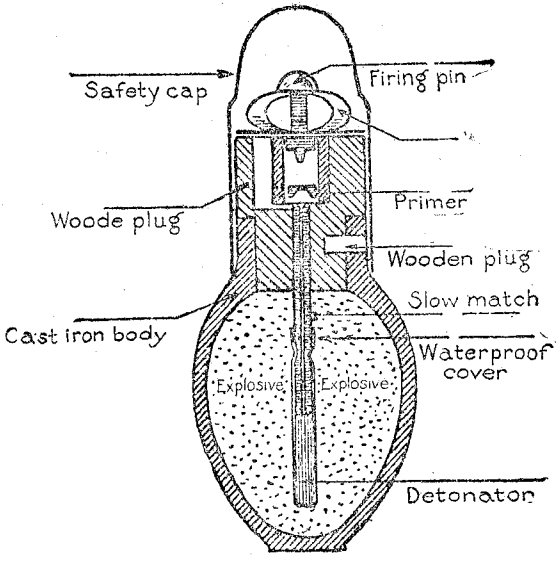


FIG. 72.

Rifle grenades.—The Vivèn Bessières grenade (V B) is thrown with the aid of a "discharger" (trombion) fitted on an infantry rifle, using the service cartridge. Another device is used on the rifle with a special blank cartridge for firing the D R grenade. This device is called a mandrel. The rifle may be fired from

the shoulder (V B), but preferably from the ground or in the position "Charge bayonets," or on a frame. The maximum ranges of the two types (208 and 383 yards) may be secured by aiming at an angle of 45°. The high angle of fall makes it possible to obtain plunging fire on the trenches.

Sixth. Grenade V B.—Cast-iron body, with interior grooves to facilitate fragmentation, grooves containing two tubes perma-

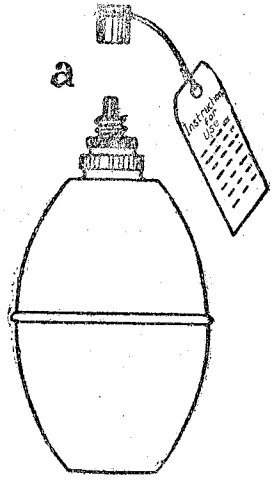


FIG. 74.

nently held in place; one lateral, which receives the igniter and detonator, and one central through which the bullet passes. The bullet strikes the primer which ignites the fuse, and at the same time, the gases of the cartridge expand into the "discharger" and project the grenade.

Method of using.—Adjust the "discharger" securely in the muzzle of the rifle. Insert the V B grenade as far as it will go,

its base resting on the bottom of the "discharger," which latter is shaped like a truncated cone. Load the rifle with a *regulation ball cartridge* and fire.

Advice and instructions.—Keep the interior of the "discharger" perfectly clean and slightly greased. Remove all rust from the body of the grenade. The primer should not project too far into the central canal, as it might be carried away by the ball without having acted on the fuse. Shipment to the armies is made in cases of 100 grenades ready to use. Weight of one case, 154 lbs. A case with handles, to contain 20 gren-

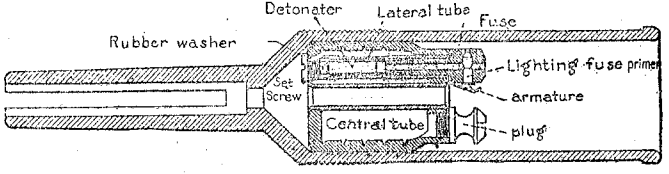


FIG. 75.—"Discharger" and V B grenade.

ades, has been adopted. Weight of "discharger" about 3⅜ lbs. Interior diameter, 1.96 in. Weight of the grenade loaded, 1 lb., 329 grains. Weight of charge, 2 oz., 50.8 grains. Period of combustion of slow match, 8 seconds with an allowance of +1 second. The gradual heating of the rifle by firing increases the range (about 20 yards at an angle of 45°). The firing table below is approximate and allows for 10 to 15 yards deviation. This table shows that if the explosion takes place 8 seconds after firing it occurs at the minimum distance as soon as it strikes the earth, and about 2½ seconds after striking the earth, if at the maximum distance.

Firing table.

Firing angle, in degrees.	Range, in meters.	Time of flight, in seconds.
45	590	5.2
50	580	5.6
55	554	6
60	512	6.3
65	453	6.6
70	380	6.8
75	295	7
80	203	7.2
85	102	7.3

Seventh. Grenade D R.—This grenade differs from the V B on the following points:

It fits onto a "mandrel" instead of being put into a discharger. It has a percussion fuse. It is fired by a special *blank cartridge*, instead of an ordinary ball cartridge. It is more cumbersome, but has twice the range and is more effective. It has a cast-iron body, elongated toward the front by a wooden ogive and a fuse and toward the rear by a swaged sheet-iron cylinder base with four vanes. This cylinder incloses the special cartridge, held in place by a pasteboard plug. Fire with the butt resting on the ground or in the position "charge bayonets," or from the special metal frame. The range is found by varying the angle at which the rifle is held, or, preferably, by maintaining an angle of 45° and regulating the volume of the expansion chamber. This is done by pushing the regulating pin into a hole corresponding with the desired distance. This pin controls the setting of the grenade on the mandrel.

Method of using.—Fix the mandrel on the rifle, regulate the angle and regulating pin; remove the pasteboard plug, extract the cartridge, and fix the grenade on the mandrel; remove the fuse safety pin; load the rifle with the special cartridge, and fire.

Advice and instructions.—Never fire with a ball cartridge. Lubricate all contact surfaces. Straighten any vanes which may have been bent. Shipment to armies is made in cases of

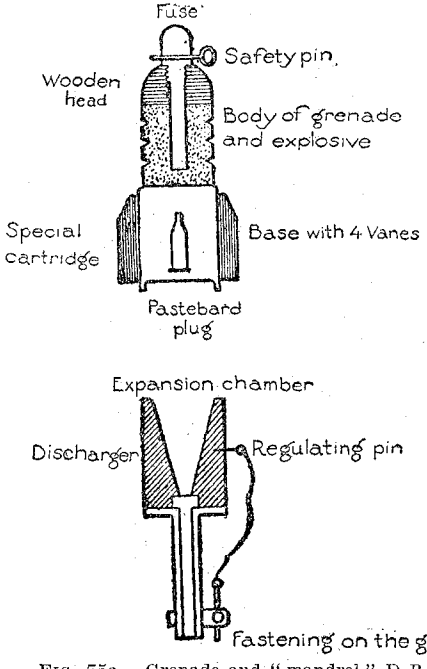


FIG. 75a.—Grenade and "mandrel" D R.

24, ready to use. Weight of one grenade, 1 lb., 4 oz., 276 grains, including 3 oz. of explosive. Maximum range, about 390 yards, to be obtained by firing at an angle of 42°, with the grenade shoved all the way down.

Eighth. Practice or blank grenades.—Distinctive colors—*Painted gray:* Loaded for service. *Painted white:* Weighted with sand, with an *active fuse. Painted red:* Filled and provided with blank fuses, or with none at all. Primers stamped with a cross: Active, to be used only with unloaded grenades. Primers pierced in several places: Inactive.

A wooden ball cartridge should be used when practicing with an active V B grenade, and, in order to insure ignition, the primer may be fixed at an angle of 45°. Never give it that angle when using a regular ball cartridge.

CHAPTER V.

THE 37-MM. (1.5-INCH) GUN.

Organization.—37-mm. gun 1916 T. R. (rapid fire). Each piece is composed of:

First. The gun, on a tripod carriage and transferable to wheels.

Second. A limber which transports the ammunition, spare parts, and accessories.

One horse can usually pull the assembled gun and limber. When near the enemy the gun and limber are separated for transportation by the gun detachment. Several guns together form a platoon. Its personnel is given under the organization of the regiment. (Pt. IV, Chap. II.)

The six men serving the piece (1 firer, 1 loader, and 4 ammunition servers) should be specialists in their duty, but each one should be able to perform any of the duties. If necessary, the gun may be served by one man.

The 37-mm. gun being an infantry arm, all officers and a sufficient number of noncommissioned officers and privates should be familiar wtih its workings.

Arms of the personnel.—The gunners, firers, loaders, and servers are armed with automatic pistols, and the remainder of the personnel with carbines and bayonets (or cavalry carbines or rifles, model 1907–1915). The platoon commander and gunner are provided with micrometric field glasses.

The firer carries the telescopic gun sight and the instrument for indirect laying.

Service of the gun.—The personnel should practice the following movements:

Unlimbering.

Pulling the gun on wheels. Two servers pull it by means of shoulder straps. The firer and loader each carry a bag of ammunition and serve as reinforcements if necessary.

Transporting by carrying. Take the gun, carriage, and wheels apart. The gunner carries the shield; two servers the tripod carriage; and each a bag of ammunition. With the aid of the rammer staff the firer and loader carry the gun. The server carries the axle and reassembles the carriage.

Butting in battery, on wheels or carriage. Change the position without dismounting the gun.

Regulating height and direction of aim by means of the telescopic sight. This should be firmly fixed on its support, the zero mark on the aiming circle being opposite the zero mark of the scale. Cock, load, fire, and suspend or cease fire.

Replace on wheels; limber up.

FIRING EMPLACEMENT OF THE GUN.

(See fig. 76.)

Fire.—First. Direct fire: Permits of the quickest adjustment and produces the most prompt results. Second. Indirect fire: Aiming at an object which is clearly visible and near the objective. Third. Masked fire: Target visible to the gunner only; aim directed at a certain point in the direction of the target.

Regulation in direction: For direct fire, adjust the aiming circle; each division on this circle corresponds to 1 mil. The deflection in mils is obtained by the gunner with the aid of micrometric field glasses or the battery commander's ruler.

In indirect fire the gunner ascertains the angle between the objective and the aiming point and lays off this angle on the aiming circle.

Adjusting the range: Try to bracket the target between a short and an over, starting with either, according to the facilities for

observation. Begin with an interval of 219 yards and gradually reduce the bracket. It is not expedient to reduce the bracket to less than 27 yards for ranges of more than 875 yards or to less than 13 yards for shorter ranges. To reduce the bracket to 54

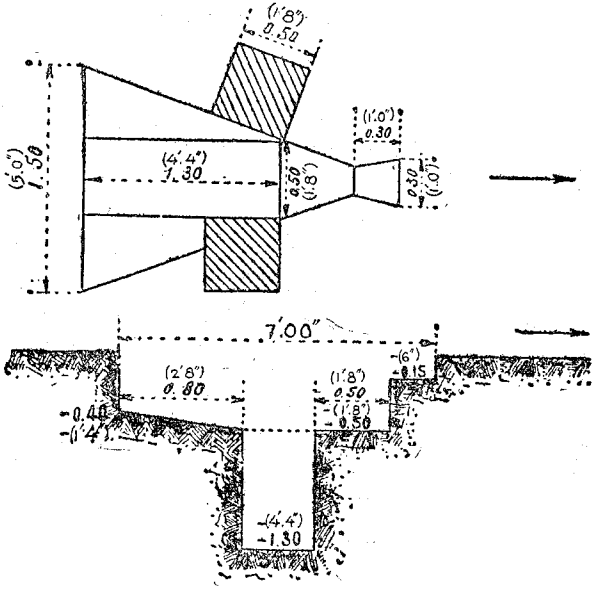


FIG. 76.

yards at least two rounds at each range should be observed before deciding whether the range is short or over. When reducing to 27 yards four rounds at each range will be necessary.

Commence fire for effect as soon as possible.

The apparatus for masked fire makes it possible to find the minimum range necessary for a projectile to pass over the mask. If that range results in overs it will be necessary to get farther back from the mask or to diminish its height.

Ammunition.—Two kinds of shell: Cast-iron shell weighing 1 pound, with percussion fuse and black-powder charge. Steel shell, base fuse, weighing 1 pound 1 ounce, 431.3 grains.

Characteristics.—Initial velocity about 400 meters (436 yards). Range 2,400 meters (2,625 yards). Average deviation: In range, from 14 to 18 yards at all distances; in direction 1 yard at 1,531, 2½ yards at 2,625 yards; in height less than 1 yard up to 1,094, 2 yards up to 1,750, and 4½ yards up to 2,625 yards range.

CHAPTER VI.

EXPLOSIVES AND DEMOLITIONS.

Allowance to one regiment of infantry.—One hundred and eight melinite petards of 4 ounces, 333 grains (in one of the tool wagons); one case containing 22 yards detonating fuse, 15 fulminate caps, and 46 detonators (in the other tool wagon). This distribution between the two wagons is because of the fundamental principle that explosives should be kept separate from the detonators. (They should never be carried together by one man, or stored in the same ammunition recess, etc.).

Sappers handle the explosives. Nevertheless, every officer must be able to recognize and, if necessary, to use properly the following explosives and devices: Melinite petard and cartridge, detonating fuse, fulminate caps, safety fuse (Bickford), igniter.

The following instructions are amplified in Instruction in Field Fortifications.

EXPLOSIVES.

Black powder.—Hard slate-colored grains of various sizes. Composition, by weight, 75 per cent saltpeter; 12.5 per cent sulphur; 12.5 per cent charcoal.

The powder is exploded either by a violent shock or by contact with a lighted body. It is a propelling explosive, to be used with tamping (when loading mines). Good powder burns without residue. Keep it dry by using water-tight receptacles. Barrels or cases of wood, zinc-lined: 50 kilograms (110 pounds). Precautions must be taken in decanting; i. e., pouring from one container to another (avoid it if possible), and transporting (use copper tools, permit no smoking, etc.).

Artillery grenades, models 1882 and 1914, were charged with black powder.

Melinite.—Melinite is a bursting explosive, and may be advantageously used for destructive purposes as a surface charge—that is, a charge placed in contact with the object to be destroyed and only slightly tamped or not tamped at all. Fused or cast melinite forms a compact straw-colored mass. It rarely responds to shock or friction. Electric sparks do not ignite it. Upon explosion it generates very poisonous gases.

Melinite must not come in contact with the alkalis (soda, potassium), especially with lead and its compounds (white lead, etc.). Its detonating quality is seriously affected by dampness, and when damp its color is bright yellow rather than straw color.

Melinite petard.—Brass envelope of elongated shape with rectangular cross section, with a welded cover carrying the primer seat, and containing 4 ounces, 333 grains of melinite. (Fig. 77.) The primer seat carries three small brass vanes, designed to hold the primer when it is introduced into the seat. It is closed by a pasteboard washer and band with a ring, which must be removed to uncover the primer seat.

Weight of petard.—About 7 ounces, 23.5 grains. Seven petards placed end to end make a charge 40 inches long and contains 2.2 pounds of melinite.

Melinite cartridge.—Cylindrical, 2.85 centimeters (1.1 inches) in diameter; charge, 3 ounces, 228 grains powdered melinite; same stopper as the petard. Petards and cartridges, being perfectly watertight, may be stored in any sort of box. Two ounces, 50.8 grains petard, model 1904, for setting off larger charges; 22 and 44 pound petards.

Chlorated explosives.—Generally used to charge bombs and grenades. These are high explosives. The principal ones are:

Cheddite.—Yellowish powder which hardens after a time, with a base of potassium chlorate and castor oil. In bulk or in paper cartridges.

Perchlorate of ammonium.—A blue explosive comprising perchlorate and *inert* paraffin.

Properties in common: They are not subject to spontaneous combustion, but ignite upon contact with a lighted body. Com-

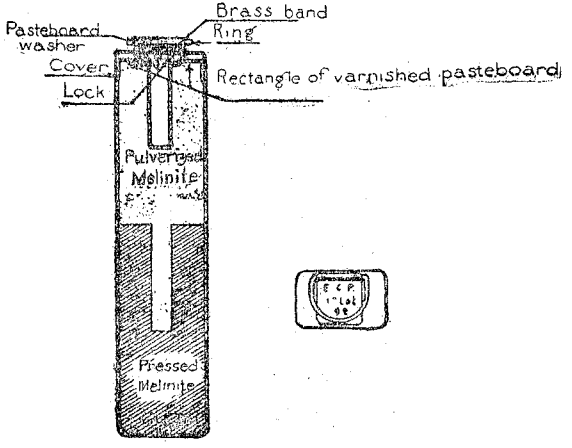


FIG. 77.—Four ounces, 333 grains petard.

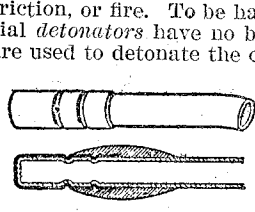
bustion can progress in a mass of either of these explosives, but will develop an explosion if the mass is sufficiently large.

Detonated by concussion (even slight) or by friction between hard surfaces. Precautions must be observed in storing and transporting. A number of small depots should be provided. The explosives should be kept separate from detonators and black powder and should not be exposed to dampness or heat. Chlorated explosives must be handled with great care. The

interior of grenades must be smooth and varnished or paraffined before filling.

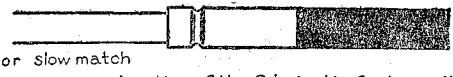
Primers and fuses.—Devices for igniting, detonating, or transmitting the detonation.

Fulminating primer 1880—Detonators.—Charged with 23,145 grains of fulminate of mercury contained in the black varnished part of the small copper tube (height 1.76 inches, diameter .217 inch). Violent explosive; very sensitive to concussion, friction, or fire. To be handled with *extreme caution.* Commercial *detonators* have no black varnish. Primers and detonators are used to detonate the charge and the detonating fuse.



Capped detonating fuse, with brass abturator and joint covered with Chatterton tape.

FIG. 78.



Fuse or slow match

Junction of the fulminating primer with a slow match or a simple fuse.

FIG. 79.

Slow match (*Bickford safety fuse*).—Small thread of fine powder .118 inch in diameter, wrapped in two layers of tarred cotton. Burns slowly, 1 yard in 90 seconds (about .39 inch per second). Time should be tested with a sample from each coil. Ignited by an igniter (see fig. 83) or directly by tinder or any other lighted body, after exposing the powder train with a knife.

Detonating fuse.—Tin tube about .197 inch in diameter, filled with powdered melinite which has been compressed by drawing out the tube. Detonates by the action of fulminate or melinite and propagates the detonator at a rate of 6,550 to 7,650 yards a second. Sometimes called an instantaneous fuse. Weight, 3 ounces, 77 grains a yard. Avoid bending it at right angles or

pulling it in such a way as to cause gaps and misfire. For greater lengths the detonation may be relayed by a 2-ounce, 50.8 grains petard or by 2 petards (fig. 88) every 219 yards. Cut off 3.94 inches from the end before using.

Alternative: Detonating or trinitrotoluol (TNT) fuse.

Joints.—Spanish windlass (fig. 86) or with two petards (fig. 88).

FIG. 80.—Joint between fulminate cap and safety fuse without crimping.

Double or multiple connections (figs. 87 and 89).—May be used for the simultaneous explosion of several separate charges. The detonating fuse is called the master fuse, to which the branch fuses are joined. Never join more than two branch fuses to a 2 oz., 50.8 grains or other petard. Tie the branch fuses to the outside of the petard.

FIG. 81.—Priming the detonating fuse.

Friction igniter, model 1913.—Lighting device which acts by withdrawing a friction wire from the composition in the tube—by means of a lanyard.

To fire, hold the unpainted end of the tube between the thumb and forefinger of the left hand—taking care not to close the ventholes. Rest the hand on something steady, slack off on the safety fuse, hook the lanyard into the ring of the friction wire, and pull it all the way out with a quick jerk of the right hand. Instead of holding the primer with the hand it can be tied to something firm.

PRIMING.

Simple priming.—Join the safety fuse to the fulminate cap. Cut the end of the fuse square and insert to the bottom of the

tube without forcing or twisting. Crimp with pliers (fig. 79), or by compressing the primer (fig. 80) where it does not contain the fulminate.

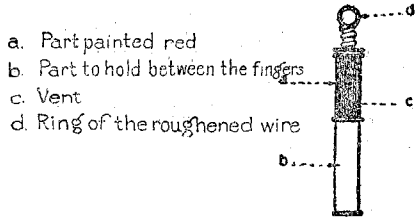


FIG. 83.—Friction primer. (Igniter.)

Priming the detonating fuse.—Prime with a fulminate cap (fig. 79) if the firing is to follow immediately. Otherwise cap

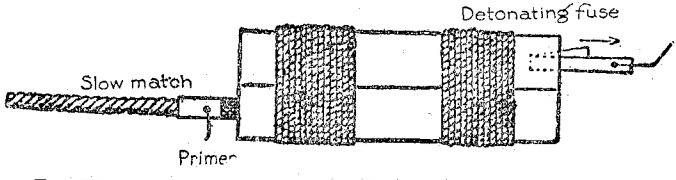


FIG. 84.—Priming the detonating fuse with a couple of petards.

the fuse with a primer, as for the Bickford, and fasten both primers together (fig. 81).

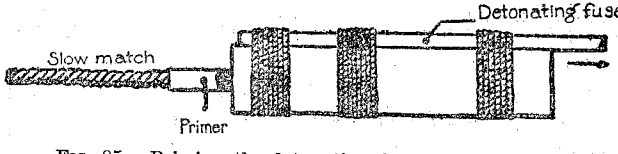


FIG. 85.—Priming the detonating fuse with one petard.

Priming a melinite petard.—First. With a safety fuse and one primer, as in figure 85. Second. With a detonating fuse like the lower petard in figure 88.

FIG. 86.—Spanish windlass joint.

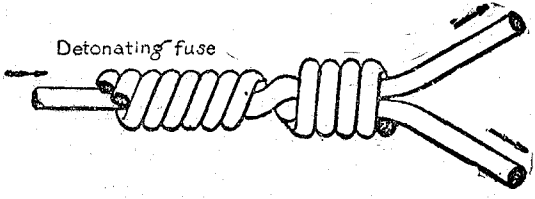


FIG. 87.—Spanish windlass branch connection.

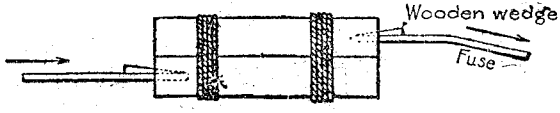


FIG. 88.—Joint with two petards.

Make the whole secure by inserting a small wooden wedge into the opening along with the primer, or by tying the primer in place.

Chatterton's Compound.—Plastic coating, which makes the joints water-tight when firing explosives under water.

MAKING UP CHARGES OF MELINITE.

1. *Concentrated charges* (fig. 91).—Packages of petards fastened together, the sockets at one end, made up as squarely as possible.

2. *Extended charges* (fig. 92).—A succession of charges placed end to end on a narrow board.

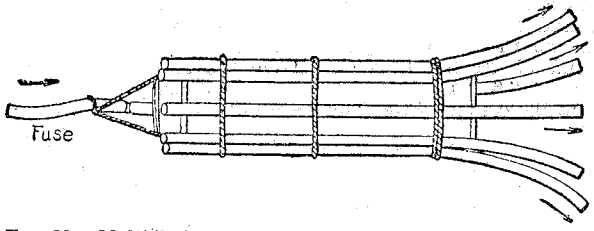


FIG. 89.—Multiple branching by use of a cartridge or a petard.

The charges are so placed that the largest surface of melinite is in contact with the object to be destroyed. A slight tamping

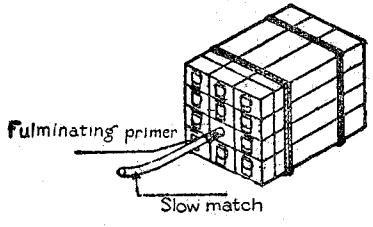


FIG. 91.—Concentrated charge.

of earth, sand, sod, etc., will augment the effectiveness by insuring contact.

Never tamp a primed petard. Tamp first, then prime.

DEMOLITIONS.

Save explosives for use in difficult demolitions, and do not expend them when the demolition can be done with ordinary tools. This will result in the majority of demolitions being made by the engineers of the division, not by the infantry.

It will suffice if officers have some idea of how to cope with the following cases:

1. *Destroying a gate.*—Set a charge of two petards on each hinge and on the lock of a wooden gate; connect them with a detonating fuse to insure simultaneous explosion. Should the lock and hinges not be visible from the outside, concentrated charges of 6.6 lbs., already prepared and primed, may be fastened to the center of the door by a nail or stick.

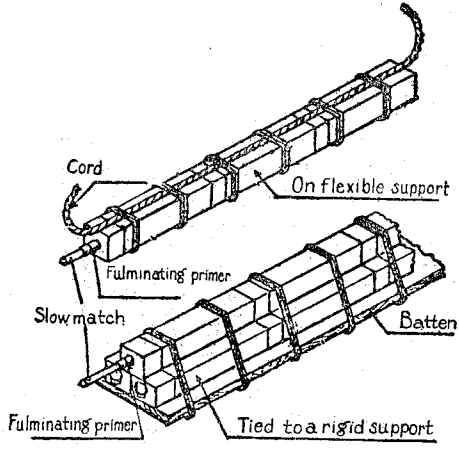


FIG. 92.—Extended charges.

2. *Disabling guns.*—A charge of four or five petards detonating in the bore near the muzzle of a gun will damage it beyond repair. Destruction will be more complete if the muzzle is plugged with earth, clay, or sod. The fuse is brought out through this plug. Unless the piece has first been covered with fascines to prevent fragmentation, move 436 to 655 yards away, after igniting the fuse, in the direction the gun points. Seven or eight petards will disable a large-caliber gun.

Another method is to slip an *incendiary hand grenade model A B* 1916, into the bore after closing the breechblock and giv-

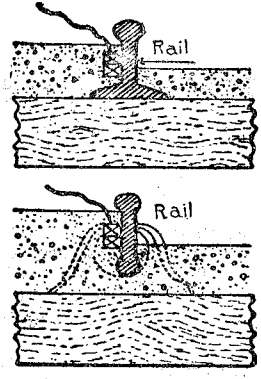


FIG. 93.—Simple fracture of a rail.

ing an inclination to the piece by raising the chase. The breechblock thereby becomes welded to the tube and the bore is ruined.

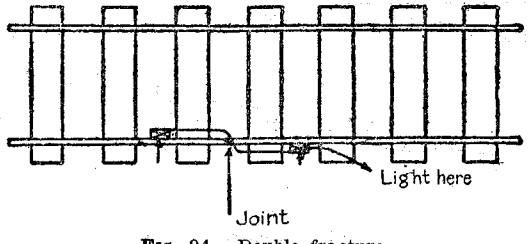


FIG. 94.—Double fracture.

Finally, in default of surer means, one can detonate a primed petard, or a grenade F_1, or bomb C F in the muzzle or against

the half-closed breechblock. But this only causes momentary damage, not always sure.

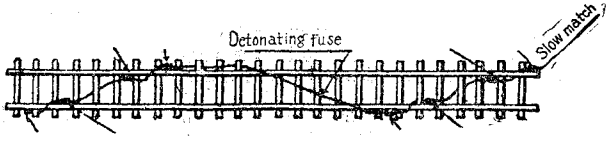


FIG. 95.—Destruction of a considerable length of track.

3. *Destruction of munitions.*—First. Cartridges: Set fire to the cases containing them with an incendiary grenade.

Second. Projectiles: The surest way is to explode two, three, or four melinite cartridges, according to the caliber of the shells, in the pile and in contact with the projectiles. Three incendiary

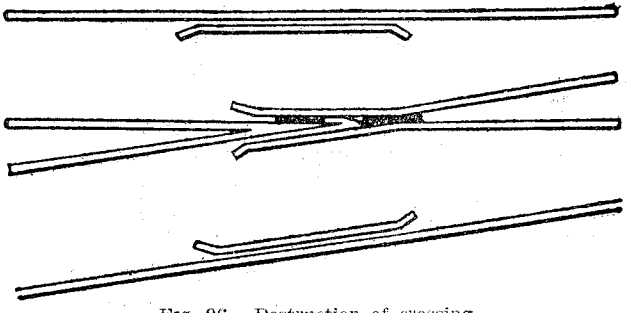


FIG. 96.—Destruction of crossing.

grenades placed on a pile of shells, even though not primed, will provoke the detonation of a certain number and putting out of service of the others.

If the shells are primed, an incendiary grenade may be lighted against one of the fuses, care being exercised to place the grenade so that the flaming liquid will not flow away from the pile. To insure the effectiveness of the latter means set fire to cases of cartridges placed at the fuse end of the pile of projectiles.

Third. Explosive grenades: Burn the cases in the same manner as the cartridges or produce detonation by igniting incendiary grenades placed on top of them. Those grenades which fail to explode will be scattered on all sides.

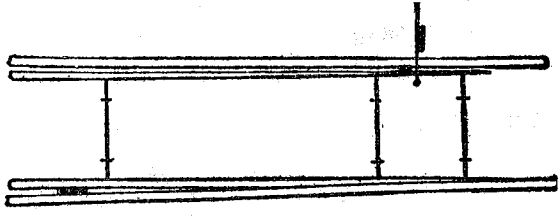


FIG. 97.—Destruction of a switch.

Fourth. Destroying railroad tracks: The quickest way is to break the rails and ties. To demolish a main-line track choose a place where the destruction will cause the greatest damage and derailments, the most serious consequences; as, for example, on curves, fills, branches, crossings, etc.

Figures 93 to 97 show the places most easily affected and the methods of applying the petards.

Fifth. Destroying an unexploded shell: Place in contact with a concentrated charge of one to three melinite petards, according to the caliber of the shell. Tamp lightly (indispensable if cheddite is used).

For the demolition of walls, iron fences, palisades, stockades, etc., see Appendix IV to Instruction in Field Fortifications.

CHAPTER IX.

ILLUMINATING ARTIFICES AND APPLIANCES EMPLOYED IN SIGNALING.

ILLUMINATING ARTIFICES.

Illuminating rockets.—Two caliber, 1.34 in. and 1.06 in. (interior dimensions of the rocket). They differ only in range and intensity of illumination.

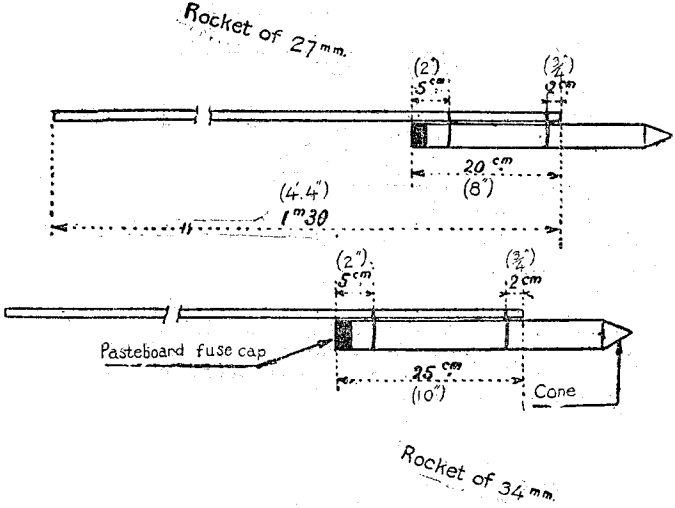


FIG. 124.

To fix the rocket stick.—The rocket stick is 4.26 ft. long, cross section 0.51 in. Attached by wires well tightened and secured, as in figure 124. The stick parallel to the axis of the rocket.

To uncover the fuse cap.—At the moment of firing, jerk sharply the loop of string placed alongside the rocket in order to tear off the cap and uncover the fuse.

To light the rocket.—The rocket being on the stand, remove the little brass cap that protects the match and brush the match composition quickly but very lightly with one of the brushes (rubbers) that accompany each box of rockets. Withdraw immediately some paces to the rear and to one side. The rocket goes off in five or six seconds after the friction of brushing.

In case of a misfire, disengage the "Bickford" (match) from the copper tube that incloses it, cut it obliquely, insert it in the wire loop that holds the copper tube, light it.

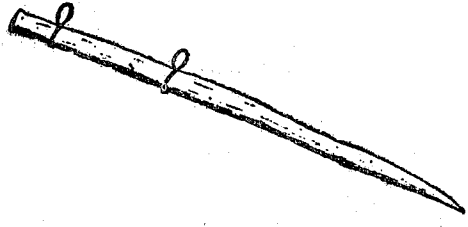


FIG. 125.—Improvised rocket firing device.

The rocket releases the parachute and star when it has traveled 273 yards (rocket 27) or 490 yards (rocket 34), about 10 seconds after its departure.

Duration of illumination, 30 seconds.

Firing stands for rockets.—The method of using this device is evident on seeing it. A fixed limb, graduated in degrees, gives the inclination of the tube guide when the pivot is vertical. The best angle is 50°. The tube guide is 4.9 ft. long; the rocket stick should enter its entire length and the rocket is turned underneath the stick. A firing stand can be improvised by arranging two collars of strong wire on any sort of a stake of sufficient length. (Fig. 125.) Rockets can even be discharged by simply sticking the rocket stick in the soft ground at a slight

inclination, but they can not in this way be discharged at an angle of 50° and there will be great variations in range and in direction.

Illuminating cartridge of 25 millimeter (1 inch) with parachute.—Long brass cartridge case, of caliber 4 shotguns of about 25.7 mm (1.1 inch) disengaging at 136 yards a star parachute that burns 30 seconds.

The illuminating cartridge is fired from a 25 millimeter (1 inch) rocket gun weighing 5.72 pounds. It is a breech-loading gun that works like a Legaucheux and that must be kept oiled. It is pointed at an elevation of about 50° in order to obtain the desired height; that is to say, such that the star will no reach the ground before it has been entirely consumed. The star possesses incendiary properties.

Illuminating star 25.—Illuminating cartridge without parachute; same caliber as the illuminating cartridge (with parachute); is fired from the same gun or from a less cumbersome special pistol. It is an expeditious lighting appliance, loosed with the least suspicious noise. It lights instantaneously and surprises the enemy. The cartridge is 3.94 inches long; the star is lighted at about 50 yards from its point of departure and illumines for six seconds while falling.

Illuminating grenade.—A cardboard pellet the size of a tennis ball, supplied with a Bickford fuse and filled with an illuminating composition. It is lighted at the end of the Bickford fuse like a Swedish match (safety match) by means of a special rubber. The ball is thrown by hand and lights for one minute the neighborhood of the point where it falls.

Illuminating bomb.—A recent appliance, intended to replace the illuminating rocket, over which it has the advantage of being invisible until the moment of lighting the star; on the other hand, the luminous train of the rocket discloses the point from which it is fired and warns the enemy that he is going to be lighted up. The illuminating bomb is a feathered metallic cylinder containing both parachute and star. Diameter, 1.97 inches. The star is lighted by a specially arranged percussion lighting device under a diaphragm, not permitting any light to escape from the base of the bomb. The bomb is projected from a special gun or by means of the V B "discharger," *but with a special blank cartridge.* Duration of illumination, 20 to 25 seconds.

DEVICES AND APPLIANCES FOR SIGNALING.

1. **Bengal lights.**—*Bengal white lights* are of three sizes, illuminating, respectively, for three minutes, one and one-half minutes, and one-half minute. Bengal *red*, *green*, and *yellow* lights are of the smaller dimensions (one-half minute illumination). They are lighted the same as the illuminating grenades. Other lights (Ruggieri, Lamarre, Coston) are also in use.

2. **Signal rockets.**—Signal rockets function the same as the illuminating rockets, model 1885 (13 white stars and 15 red stars, burning 10 seconds), and *big star rockets* (white, red, and green), which have 6 stars only, but plainly seen by day, are the two kinds most used. These rockets have the cone painted the color of the stars; big star rockets have also a band of paint around the middle of the body of the rocket. Other varieties are in course of construction: Caterpillar rockets, rockets with red or yellow smoke, flag rockets, etc.

3. **Signal cartridge 25.**—Called also "military telegraph star." The star is *white*, *red*, or *green;* it lasts eight seconds. The color of the wad indicates the color of the star. These devices must not be confused with *star illuminating cartridges* previously described, although both have the same appearance, same length, and the same caliber (length, 3.94 inches; caliber 4). The latter owe their lighting power to the brilliant combustion of aluminum, while the signal cartridges project a star that can be seen at a distance, but which does not illumine the ground. The signal cartridges are therefore fired vertically to indicate where one is, or in the direction of the post with which one desires to communicate.

A 25 caliber breech-loading bronze signaling pistol is used, weighing about 2.2 pounds and having a diameter of 1.04 inches. The same pistol can fire cartridges with three stars, cartridges with six stars, red-smoke cartridges, and yellow-smoke cartridges.

4. **Signal cartridge 35 for infantry.**—The 35 mm. (1.38 inches) cartridge consists of a base and a sheet steel case. Three models: Cartridge No. 1, 1 white star, for 10 seconds; cartridge No. 3, 3 white stars, for 8 seconds; cartridge No. 6, 6 white stars, for 5 seconds.

Distinctive marks: One, three, or six large points projecting from the end of the cartridge opposite the base; and a round vignette stuck on the base, indicating "Infantry signal No. 3." Weight, cartridge No. 1, 7 ounces, 255 grains; No. 3 or 6, 10 ounces, 100 grains. Charge of powder F.3, 69.435 grains. Range: Fires vertically, the cartridge functioning at about 109 yards high, after three seconds. Packing: Packages of 24, six packages in a box. This cartridge is fired from a breech-loading .35 caliber signal gun weighing 9.46 pounds. Cartridge No. 1 can be used for lighting or incendiary purposes. Maximum range, 219 yards.

5. **Thirty-five caliber signal cartridge for avions.**—The same as the preceding, but loaded with only 38.57 grains and fired from *signal pistol, .35 caliber,* special for aviators. Beside the three models described, there will eventually be the following: Two stars, caterpillar, red smoke, yellow smoke.

6. **Signal devices that may be used with the V. B. "discharger."**—The V. B. "discharger," using a special blank cartridge, can throw the following: Parachute stars, red, white, green; one star, three stars, six stars; caterpillar; red smoke, yellow smoke.

7. **Signal lanterns.**—Old allotment, two per company. To be replaced progressively by the *portable searchlight.*

Description.—The lantern consists of a sheet-iron box inclosing: *A projector* formed of a polished silvered mirror and an electric lamp mounted on an adjustable support; *a sighting tube* with the axis parallel to that of the parabolic mirror; *a flexible hand manipulator; a battery* (4 volts) and four extra light bulbs; *an extra battery* is contained in a bag.

Method of using.—First, draw forward the manipulator button after having opened the side door. Close the door. Second, face the party to whom signaling in such a way as to bring the party or person in the middle of the field of the sighting tube. Third, manipulate with the thumb or the index finger of the right hand. Observe during the transmission of the message that the sighting tube is accurately directed on the receiving party.

Care and adjustment.—To replace the battery open the side door and loosen the screws of the two binding posts situated under the exchange lamps; take out the used battery. Scrape

the wire ends of the new battery and slide it in the lower compartment of the lantern, the longest wire having its point of departure against the bottom. Engage the scraped ends of the wires in the binding posts and fasten the posts to the bottom.

To replace the lamp dismount the glass by turning it gently until the notches correspond with the catches. Unscrew the bulb, replace with another from the reserve, screwing it well in. Replace the glass in its seat, turning it so the wards will correspond with the catches. Adjust the bulb so that the filament will be at the focal point of the mirror. To do this, turn the light on a wall at 5 or 6 yards distance, and turn the adjusting screw at the rear of the lantern until the image projected on the wall is as brilliant and as small as possible. Range by day, 500 to 1,000 yards; at night, 1,000 to 3,000 yards.

8. **Portable searchlight 14 (5.51 inches).**—Allotment, two per company, three per battalion, three per brigade, three per division. The three battalion lights are inclosed in the same box which contains 12 extra batteries, 6 extra lamps (3 white and 3 red), 2 packages of cotton wool.

The *14-centimeter (5.51 inches) light* is similar to the *24-centimeter (9.44 inches) light* described hereafter. Its use, care, and adjustment are the same. Range by day, 1,000 to 3,000 yards; at night, 2,000 to 6,500 yards.

9. **Portable searchlight 24 (9.44 inches).**—Allotment, four per regiment, three per brigade, four per division. This light is designed for signaling between two stations on the ground or between the earth and an avion or a balloon.

Description: The apparatus includes a portable projector with a cap or cover, a sighting tube, an insulated connecting wire, and a screw plug. (Fig. 126.)

A waist belt with suspender or sling, carrying two battery pockets, each inclosing four cells, and one central pocket carrying the manipulator (sending key); the current regulator; two extra light bulbs. The projector box contains eight battery cells and three extra light bulbs.

Manner of using.—Screw the connecting plug into the socket on the battery box. Remove the cover and direct the projector toward the receiving party by means of the sighting tube. Signal by pressing the manipulator with the right hand. Be sure that the sighting tube rests exactly on the receiving party

during the transmission of the message. The apparatus can be held in the hand or placed on any convenient support. To

FIG. 126.—Portable searchlight.

communicate with an avion, the projector is held in the left hand and rested against the left shoulder. To communicate with a person on the ground, the apparatus can be held in the left

hand, resting against the breast. For long messages it is preferable to rest the projector on a support.

Care.—Whenever the instrument is not in use, be careful to keep the cover firmly closed in order to protect the mirror. Do not pull on the cable fixed at the back of the projector, especially in removing it from the box. Touch the mirror as little as possible; clean it with gauze or cotton wool, washing it when necessary with clean water.

Adjustment.—The apparatus is delivered adjusted; but it may happen that, in changing lights, the source of light will no longer be at the focus. To adjust it, turn the lighted projector on a well a few yards distant and turn gently the mirror regulating screw until the spot projected on the wall is as brilliantly illumined and as small as possible. Range by day, 1,600 to 6,500 yards; at night, from 3,000 to 1,100 yards.

Red light.—The 14 and 24 centimeter (5.51 inches and 9.44 inches) searchlights can use red light when necessary to distinguish signals from certain parties or stations. Red lights are, in general, reserved for searchlights pertaining to the artillery. Red light reduces the range of the searchlight markedly.

Important note concerning lanterns and projectors.—*The lights are fed by batteries which speedily become exhausted if employed in giving a continuous light. It is expressly recommended that they should never be put to the use of fixed lights. The use of signal apparatus as a means of illumination is most positively forbidden.*

10. **Square flags for signaling.**—Allotment, 64 per regiment. Dimensions, 19.68 in. The staffs fold for transport. The two faces are half red and half white, colors disposed diagonally. This arrangement of colors is the most advantageous for all-round visibility. Observe arm signals with a field glass.

11. **Panels.**—Panels used in communicating with avions are of different types, and their significance varies in order to preserve the secret.

A. *Identification panels.*—White circular panels 5 yards in diameter are employed to identify divisions and brigades. This is accomplished by means of four strips or slats 3 yards long fastened in the middle by a bolt and terminating in a closed hook. The linen panel has eight rings that are engaged in the hooks. (Fig. 127.)

The *semicircular white panel* of 3 yards indicates a regimental command post.

The *triangular white panel* with 2-yard sides indicates a battalion C. P.

B. *Persian panels.*—These panels admit of the alternate appearance and disappearance of a white rectangle, 3.9 by 9.2 feet. By working a shutter, there is exposed either the white

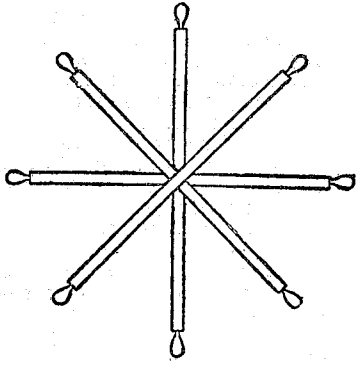


FIG. 127.—Frame of a circular panel.

face or the neutral face of seven strips (bands) of white linen, 3.9 by 1.3 feet, doubled with gray or khaki. Allotment, one per division, brigade, or regiment.

C. **Panels to indicate the infantry firing line to aviators observing for artillery.**—Panels 1.6 by 1.3 feet of waterproof linen, white on one face and neutral on the other. Allotment, 64 per regiment.

Panels are to be displayed only in the first line.—Leave them spread only until the avion has signaled "understood," *and in no case for more than 15 minutes.*

Recapitulation table.

	Signalers.		Searchlights.		Panels.		
	Officers and non-commissioned officers.	Squads of two signalmen.	24	14	Identification.	Persian.	"Marking firing line."
Reg.....	2	4	4	0	1	1	64
Bn.....	1	2	0	3	1	0	0
Co.....	0	1	0	2	0	0	0

CHAPTER X.

THE TELEPHONE.

TELEPHONE FOR INFANTRY.

Two types.—1. Model 1908, buzzer. Light, strong, works on badly insulated lines. Requires special switchboard for buzzer.

2. Type, model 1909 or 1915, with magneto and buzzer. A little heavy. Permits calling artillery equipped with special switchboard, and also rings a bell.

Batteries.—Dry nonrechargeable batteries are used. The following is necessary in order that they should run a long time: *Do not put them in a damp place.* Do not weaken them by prolonging the calls or by leaning on the pedal of the phone when not in conversation. Avoid short circuits produced by wire touching two binding posts of the same battery. A single short circuit of a few seconds ruins the cell irremediably.

When the batteries are new, a single cell suffices to operate a telephone. When it becomes weak, a second is put in.

All telephones are in wood boxes that deteriorate when exposed to moisture. Therefore avoid putting telephones on moist ground or in the grass. Under shelter be careful to attach to a shelf or a plank.

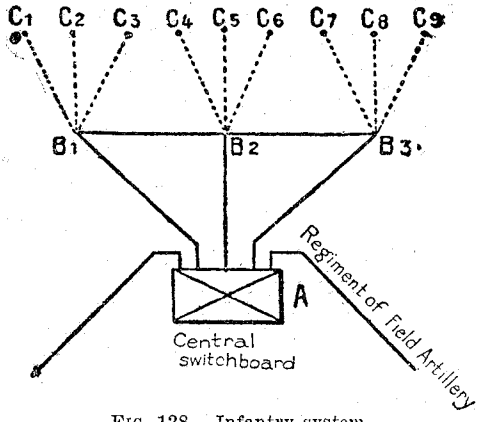


FIG. 128.—Infantry system.

FIG. 128.—A. Command post of the colonel. B. Command post of the major. C. Command post of the captain.

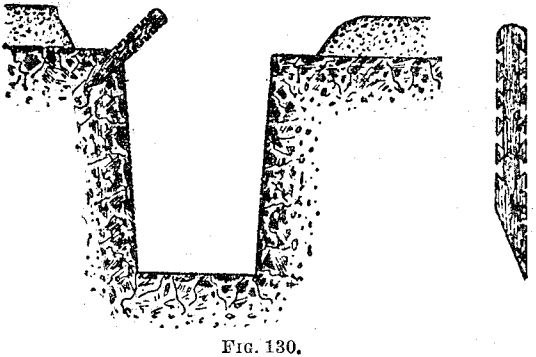


FIG. 130.

Conductors.—Infantry uses insulated wire, light cable, and, in exceptional cases, field cable, double cable, armored cable, or leaded cable.

Insulated wire is reserved for transient connections in maneuver warfare (15/10 bronze wire). *Light cable* is the normal conductor in the trenches. It should be laid with care and isolated from the ground as much as possible (hung on pulleys, stakes, etc.). *Field cable* is used for important lines. It is useful, often indispensable, to bury it so as to protec it from bombardment (in grooves in the bottom of trenches or under the macadam of roads; small trenches, 40 centimeters (15 inches) deep, covered by a light covering).

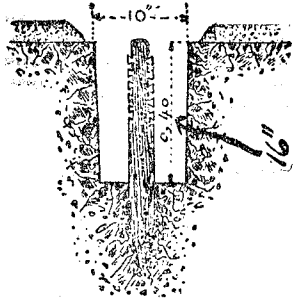


FIG. 131.

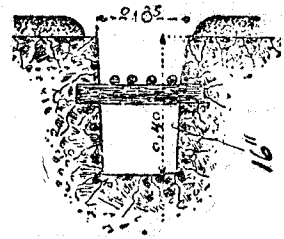


FIG. 32.

The double cable has two conductors in order to prevent the enemy from surprising communications. Its use is in the first line, or for important connections in maneuver warfare.

REGIMENTAL PERSONNEL AND MATERIALS.

A telephone party is composed of one sergeant, five operators, two telephones, one switchboard with four switches, 2 kilometers (1¼ miles) of light cable.

In a regiment of three battalions there is a telephone officer, eight workmen, a reserve of four telephones, two switchboards, and 14 kilometers (8.7 miles) of cable.

PRECAUTIONS AGAINST SURPRISE OF COMMUNICATIONS.

All teephonic liaisons in zones less than 2,200 yards from the eney are of *double wire;* that is to say, with metallic return; *ths rule is absolute.* Furthermore, it is absolutely prohibited i the first line to allude by telephone to any event or situation that might be of use to the enemy, such as hour of attack, rliefs, number of regiment, neighboring regiments, brigades, etc. *In general people telephone entirely too much during peiods of inaction.* It is necessary to impose, and to impose ononeself, the use of *messages* instead of *conversations.* The officer who sends a message is more brief, weighs his words more carefully, and avoids imprudent remarks. Furthermore, he keeps a copy of his message. Questions of "priority" must be clearly egulated.

PRECAUTIONS TO ASSURE THE MAINTENANCE OF COMMUNICATIONS.

Telephonic connections (liaisons) are of vital importance to the units of the first line. Everyone, whatever his position, should work diligently to maintain them. It is therefore strictly the duty of ayone who observes a broken line to repair it, or at least to inform immediately the nearest emergency telephone repair party. Patigue parties, reliefs, and patrols circulating at night should gie the lines the most careful attention; carry the weapon slung, ointed down. The arrangements indicated in figure 130 concrn only trenches of 2 yards depth. In other cases it is bette to plant the notched stake at the bottom of the trench againt the wall. Trench crossings should be made with great care. The best method is to pass the line under the trench in a woode conduit, using leaded cable for this passage. If the crossing isabove the trench, see that the wire is well stretched. String alongside a pole.

To repair a line,it is sufficient to scrape the insulation from the wire at both eds of the cable, knot them together, then

isolate the splice from the ground by means of a rag, a piece of paper or wood, or a bit of cardboard. As soon as possible this splice should be covered with tarred tape, which will insulate it completely.

TAGGING AND ORDERLY ARRANGEMENT OF LINES.

A means of identifying lines circulating in the same trench is very important. Care should be taken never to string lines over those already placed (duplication). Furthermore, every 50 yards of each line should have a tag firmly attached to it indicating the origin and end of the line. Every unused line should be recoiled the very day it ceases to be of use.

MEANS OF OBSERVATION AND RECONNAISSANCE.

CHAPTER XI.

SANCE.

FIELD GLASSES—PERISCOPE—COMPASS—MAPS, SKETCHES, AND PLANS.

1. **Field glasses.**—To be remembered: Field glasses of the highest power are not the most advantageous for an infantry officer, for unless considerable dimensions are given the object glass, thus rendering the instrument cumbersome, this enlargement is always obtained at the expense of *field of view and clearness*. If two field glasses have object glasses of the same diameter and one magnifies twice as much as the other, its *clearness* will be only one-fourth that of the weaker glass. A magnifying power of 6 or 7 diameters, a field of 100 to 130 mils, with corresponding clearness, gives, for the prismatic field glass, the best balance between the conflicting qualities.

2. **Periscope.**—A periscope is ordinarily composed of two mirrors, M_1 and M_2, or two reflecting prisms whose faces are *parallel to each other* and inclined at an angle of 45° to the tubular mount.

Figure 133 shows that the result is as though the eye were placed at O′ in place of at O and looked through a window of the dimensions of the opening arranged in front of M_1. The result is that with the same mirrors *the longer the periscope the smaller will be the field of view.* It is therefore not practicable to increase the length of the periscope indefinitely. Seventy centimeters (28 inches) is good height for service.

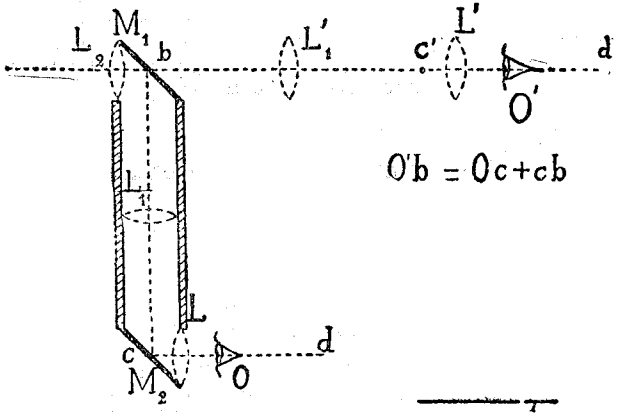


FIG. 133.—Periscope.

Again, the mirror can hardly have a width greater than $2\frac{3}{4}$ inches, in view of the danger of being seen and destroyed by the enemy. Under these conditions, a periscope 28 inches high reflects to the eye a horizontal strip of ground only 10 yards wide at a distance of 110 yards. On the other hand, the vertical field of view is almost always sufficient.

If one looks in a periscope through a field glass, the image is enlarged and clearness is increased, but the field of view is not increased.

In folding and sliding periscopes, it is necessary to carefully observe and preserve exact parallelism of the mirrors.

The *Carvallo periscope*, indicated in figure 134, is held in an inclined position, with the observer's back toward the object observed. As in the ordinary periscope, there is no inverting of objects; that is to say, one can read writing placed in the field of vision.

FIG. 134.—Carvallo periscope.

There are also *periscopes of precision*, having a field of view of 280 feet at a distance of 110 yards. They are constructed with magnifying lenses L, L_1, L_2 (fig. 133), and function as though L^1, L^1_1, L^1_2 formed a straight telescope. Their construction is expensive.

Another application of the periscope.—When one can observe in the open, the periscope permits the exaggeration of features in relief. This is accomplished by holding the instrument horizontally before *one* eye and observing the country directly with

the other eye. Slight rotations of the periscope about its axis makes possible, by groping, the superposition of the two fields. The relief of features then suddenly becomes extraordinary and different foregrounds detach themselves from each other with great clearness. Recognition of moving objects on the horizon is also facilitated.

3. *Compass.*—The blue end of the needle indicates the *magnetic north.* Compasses are graduated from 0° to 360° (or from 0 to 400 grades, or from 0 to 6,400 mils) in the direction of the figures on a clock. The line 0–180 (or 0–200 or 0–3,200, depending on the type), which generally bears the indications N. S., becomes the geographic north and south line when the blue needle point is (for Paris) 13½° (15 grades or 240 mils) to the left of the 0 of the compass. The compass most widely used is one with a needle 1½ inches long and the bottom of which, moving with slight friction on the rest of the box, carries a large black direction arrow, concentric with the magnetic needle. There is added a small copper protractor. The precision of the measurement of angles is in proportion to the length of the needle. The needle is influenced by the presence of iron (helmet).

To orient a map.—Place the compass on the map, the 0-180 line on the meridian. Turn the map carrying the compass until the blue point marks the proper declination. The map is then oriented.

If, instead of meridians being marked on the map, an arrow indicates the true north (N. G.), place the compass so that the 0-180 line coincides with the direction of the arrow. Turn the map bearing the compass until the needle indicates the declination. If the magnetic north is given, place the 0-180 line coincident in direction with it and turn the map with the compass till the needle is at 0. This dispenses with the necessity for laying off the declination with the needle, the declination varying with the locality. (Translator's note: The above will only give correct results when the declination laid off is the true declination of the locality in which the map is being used; or, in the last case, when the magnetic N, and S. line indicated on the map is the true magnetic meridian for the place in which the map is used.)

To take the direction or azimuth of a distant object (fig. 135).—Clean the face, direct the arrow on the object as accurately as possible, and turn the rest of the box so that the blue needle shall stand at zero. The object then is at 138° (from the *magnetic* north) measured in the direction of the movement

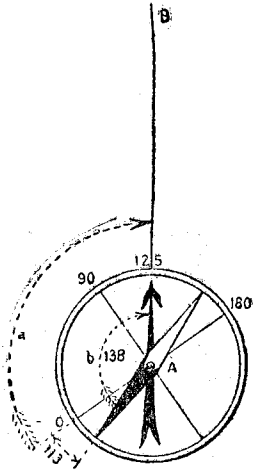


FIG. 135.

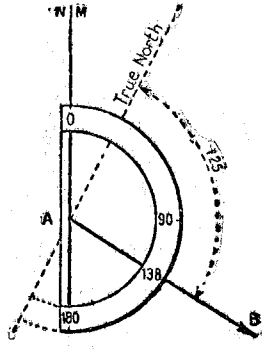


FIG. 136.

of the hands of a watch. For greater precision put the compass on a fixed support and take the mean of several readings. The angle "*b*" is called the magnetic azimuth of B.

If the compass box had been moved until the needle marked the declination (assumed at 13° in this particular place), the reading of the black arrow would have been 125° instead of 138. The angle "*a*" thus read is called the geographic azimuth of B.

Knowing the location of the observer on the map, to plot the direction of a point seen (fig. 136).—Let A represent the ob-

server's station on the chart or map. Draw through A a line parallel to the magnetic meridian; lay off with the protractor a second right line through the point A making an angle of 138° with the first, measured in the direction of the movement of the hands of a clock. The point B will lie somewhere on the right line AB.

If a line is drawn through A parallel to the geographic meridian, the same result is obtained by laying off an angle of 125°.

Knowing the location on the map of a point seen, to draw a line through this point and the observer's position (plotted

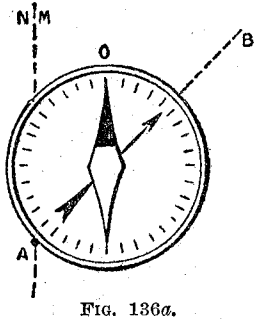


FIG. 136*a*.

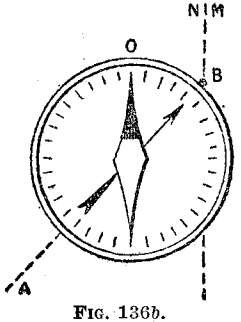


FIG. 136*b*.

(fig. 137).—Let B represent the location on the map of the point seen. Draw through B a line parallel to the magnetic meridian, apply the protractor, directing the limb toward A, draw the line B-138, the point A will be somewhere on that line.

Proceed in a similar manner using the geographical NS and the angle 125°.

REMARK.—The foregoing operations may be performed by use of the compass alone, without using the protractor. Suppose the map is oriented. Place the compass on the map in such a way that the edge of the compass corresponding to the prolongation of the feathered end of the black arrow is at A

(fig. 136-a) and pivot the compass around this point (*not* around the center) until the blue point of the needle is at zero; the compass will then occupy the same position on the map that it had in the country when taking the azimuth of B. All that remains to be done is to mark on the map a point in prolongation of the black arrow and join this point with A to obtain the line AB.

Working in reverse to the above-assumed condition, with the arrow on B as the supposed known point, the unknown point A will lie in the direction of the feathered end of the arrow (fig. 136-b).

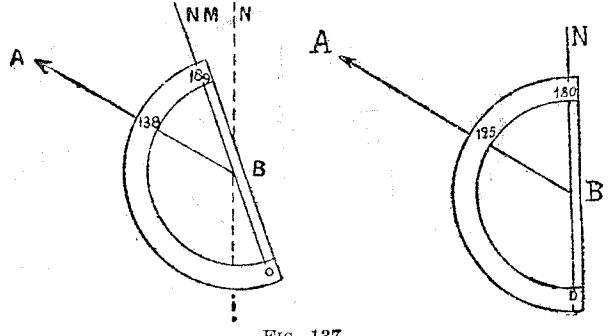


FIG. 137.

This method has a double advantage. It dispenses, first, with reading the angle; secondly, with the use of the protractor, a fragile instrument and a source of errors.

If one hesitates between two possible positions (p) of the protractor along the meridian of B (fig. 138), it will only be necessary to consider if the point A should appear east or west of the point B. Furthermore, in both positions the line 0–125° gives BA, or its prolongation.

These operations are the only two that can arise in the use of the compass and protractor.

The processes by use of location by direction and distance, intersection, bearings, and offsets are single, double, or triple applications of these two operations for establishing azimuths.

Sketching by compass.—It is beyond the scope of this Manual to insert in it an abridgment of topography. There will only be recalled the four operations that, combined with measurement by paces or tape, enable every officer and noncommissioned officer having elementary notions of geometry and drawing to execute a ground plan sketch of some value.

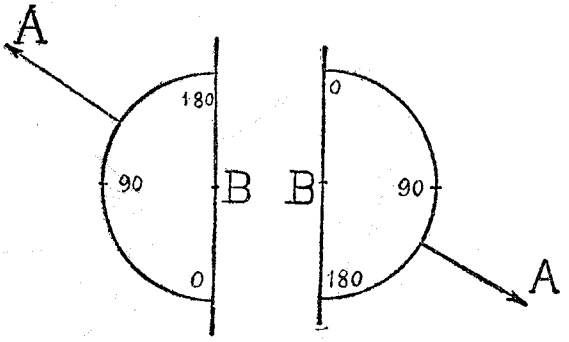


FIG. 138.

All sketches proceed from the known to the unknown. The known features constitute a skeleton, constructed in advance by enlarging an assemblage of points or lines taken from a good map of small scale; this skeleton is a sketch already established that we propose to complete or to extend beyond its present limits; it is also, if one has no anterior document, a *base* that is chosen arbitrarily, but sufficiently long, on the ground to be surveyed (on a road a right line if possible) and of which the length and azimuth should be measured with great care.

Knowing then at least two points of the terrain, their position on the sketch and the direction of the north, one of the four operations following will permit the deduction of certain others

successively from it, between which intermediate objects are sketched in from sight.

Location by direction and distance.—Knowing A, to locate B; being at A, take the azimuth of B, record it; measure AB, reduce to scale, from whence we have (b).

Intersection.—Knowing A and B, to establish c, take the azimuths AC and BC, their intersection gives (c). (Fig. 140.)

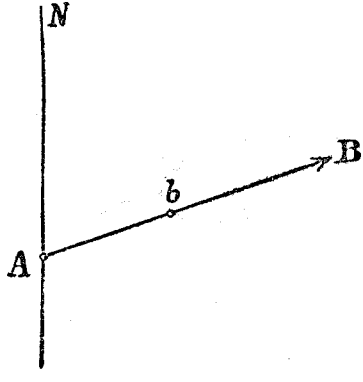


FIG. 139.

By bearings.—Knowing A and B, but being at C, to establish C, take the bearing CA and CB, plot them, their intersection will be (c). (Fig. 141.)

By resection.—Knowing that C is somewhere on the line AB, and knowing D, take its azimuth, plot DC; the intersection of DC with AB will be at (c). (Fig. 142.)

These operations require for precision that the construction lines intersect at nearly right angles. Points should be selected accordingly. Make frequent verifications by supplementary bearings or by distance measurements, and thus obtain three or

more intersections instead of two by which to locate the point sought.

The sketch completed and a fair copy made, draw the orientation arrow (N. S. or N. M.–S. M.); construct a scale, or, at least, write what it is; indicate the date of execution of the sketch, the name of the person who made it, any unusual signs or symbols employed.

State briefly the method employed in making the sketch, in order that the person using it may have an idea of its exactness.

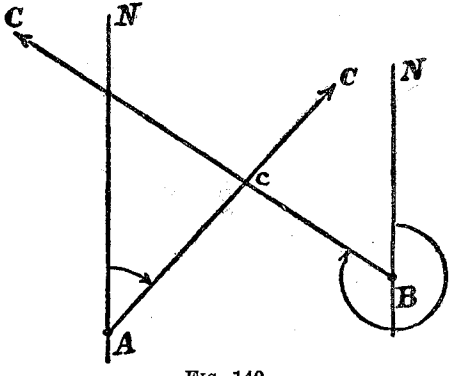


FIG. 140.

For example: Sketch by eye, distances estimated by the watch; or, plotted from paces and compass bearings, 2-inch compass; or, from map of 1/80000, enlarged and completed by sight, etc.

If it is a question of correcting an old sketch, note: "Date of last corrections, the _____."

Make the work legible. Do not exaggerate the size of conventional signs, which are always large enough when they are legible (width of roads, houses, etc.). Never forget for an instant, either in drawing or writing, that you are not working for yourself, but for others.

4. **The direction compass.**—The compass described above can serve as a "*direction compass*," as well as several different models constructed specially for this purpose (Rossignol compass, etc.). These other instruments are accompanied by explanatory notes the apparent complication of which sometimes

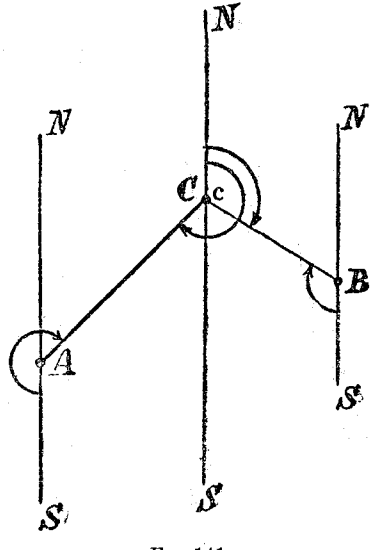


FIG. 141.

increases the difficulty. The problem can, on the contrary, be solved very simply by every officer and noncommissioned officer without having to remember anything from these notes. (Fig. 143.)

Trace in pencil the line (ab) on the map, and a magnetic meridian, if it is not already traced on the part of the map used.

Spread the map (on a table, the ground, a map case, after having folded the useless edges under). Place the compass on the map with the line 0–180 on the magnetic meridian and turn the map supporting the compass until the blue point is at 0. The map is then oriented. Without moving the map, place the com-

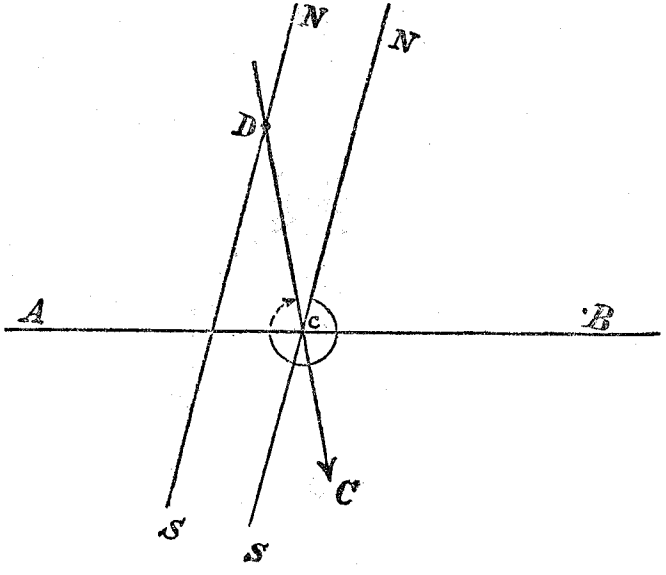


FIG. 142.

pass on the line (ab) and turn the black arrow so as to cover the line (ab), the blue point remaining at 0, and observe the compass division at which the black arrow points. In this situation it is evident that the black arrow points in the true

direction sought, at B. Now take up the map and the compass; it is evident that every time the compass is placed—no matter where, provided only that the arrow is at the same reading as before and the needle at 0—the direction sought will be again at the end of the arrow.

Similarly, the geographic meridian may be used to orient the map, in which case the needle is set to mark the declination

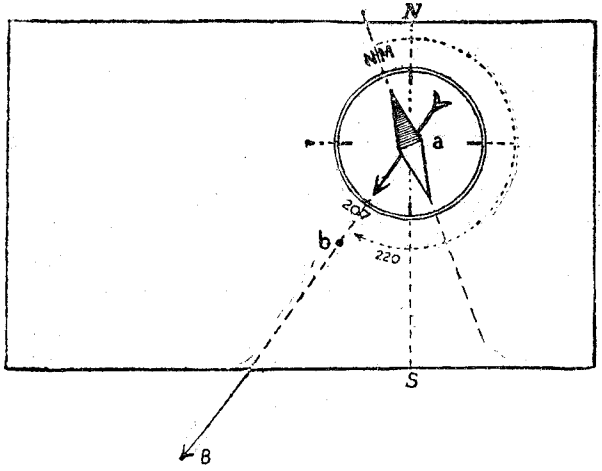


FIG. 143.

(13° to the west), and 207 is read instead of 226. The operation is therefore as follows: Without moving the compass, place the eye behind the arrow, and, if using it for determining successive points of direction, take the most distant ones possible in order to avoid needlessly repeating the operation.

5. **Maps and plans.**—A map differs from a plan in that its scale is too small for interesting objects to be represented on it

in their true size reduced to scale, for they would be imperceptible; a road 8 meters wide would, on a map of 1/80,000, be represented by one-tenth of a millimeter. Use is therefore made of conventional signs whose dimensions have no relation to the real size of the roads, houses, bridges, etc., that they represent. Scales most frequently employed for maps are: 1/320,000, 1/200,000, 1/100,000, 1/80,000, 1/50,000, 1/20,000.

On the contrary, in a plan of 1/2,000, for example, a road 7 meters wide will be represented by two lines $3\frac{1}{2}$ millimeters apart; that is, 7 meters divided by 2,000. The scale 1/10,000 marks the transition from maps to plans.

Maps and plans are executed by regular means and are based upon methodical measurements.

The term *sketch* should be applied to all representations of terrain executed rapidly and by the means at hand, sometimes even from memory and from information given without any guaranty of exactness.

The *reading of maps* can only be taught by practical instruction on the ground.

Orientation.—To orient a map is to direct one of its meridian or N. S. lines toward the true north and south. It is also to direct the line of the magnetic north of the map (when it has one) in the direction taken by the blue point of the needle. When the map is oriented all objects on the map are parallel to the real objects on the ground.

Orientation by the sun can be made (with errors of 10°) by knowing where one is, and also a distant visible point shown on the map, on which alignment is made, and by the pole star. Nothing equals a good compass.

Scales.—For any map, sketch, or chart, one should be able to determine at once its scale by the application of the following rule: *One millimeter on the map represents as many meters on the ground as there are thousands in the denominator of the scale.*

Examples:

$\frac{1}{20000}$, 1 millimeter represents 20 meters.
$\frac{1}{375000}$, 1 millimeter represents 375 meters.
$\frac{1}{2500}$, 1 millimeter represents $2\frac{1}{2}$ meters.
$\frac{1}{400}$, 1 millimeter represents 40 centimeters.

In the scale 1/80000, 1 millimeter represents 80 meters; 1 kilometer is represented by 12½ millimeters. The diameter of a 5-centime piece measures (to this scale) exactly 2 kilometers. The sheets of the map are 40 kilometers by 64 kilometers; quarter sheets are 10 by 32 kilometers.

The sides of the cadre are divided exteriorly into *degrees* and interiorly into *grades*. The *centigrades* of the vertical sides—that is to say, the meridians—are invariably 1 kilometer apart. Do not confuse with the centigrades of latitude (horizontal sides of the cadre), which vary in length according to their distance from the pole.

Finally, for rapid estimates one should be able to estimate a kilometer by means of the width of the finger, the length of a finger nail, etc., conveniently standardized.

CONVENTIONAL SIGNS EMPLOYED OBLIGATORILY ON MAPS OF SCALE OF 1/5000 AND LARGER.

(Sketches, reports, etc.)

Projected trenches or approaches.
The same, commenced and partially serviceable.
The same, finished and occupied.
The same, deteriorated and become unserviceable (partial erasure of preceding conventional sign). Trenches in red or black ink. Approaches in green or black pencil.
Subterranean communication.
Elevated trench, with gabions.
Compulsory direction of movement.
Small post; barricade or defensive traverse.
Footbridge. Steps.
Wire entanglement, attached to posts.
Brun entanglement. (Wire in collapsible spirals.)
Other accessory defenses.
Command post of a battalion commander (or colonel or general).
Command post of a company.
Telephone station.
Telephone line.
Visual signal station.
Relay of runners.

1716—17. To face page 130.

Fig. 65a.

Depot of cartridges, grenades, and bombs (trench weapons).
Depot of materials and tools.
Depot of food.
Watering place.
Dressing station.
Bomb-proof shelter No. 7, for 12 men.
Light shelter No. 4, for 20 men.
Observing station.
Machine-gun emplacement, occupied.
Machine-gun emplacement, prepared.
Casemated shelter for machine gun, occupied.
Casemated shelter for machine gun, prepared.
Trench artillery and appliances, emplacements occupied (by three 58 mm., two 37 mm., and one pneumatic).
Same, prepared (for two 240 mm.).
The corresponding works as shown above, but under construction.
Emplacement for automatic rifle.
Rifle grenade battery (of 4 V. B. rifle grenades).
Battery (two 120 mm. and four 75 mm.).
Edge of a wood.
Drain for the disposal of water.
Limits of districts or subdistricts.

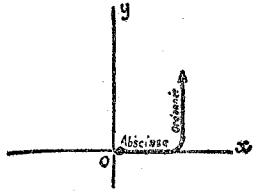
NOTE.—Demolitions are shown in yellow crayon.

Designation of objects on checkered maps.—Guide plans and maps of scale 1/50,000 which are in observation stations and command posts (C. P.) are divided into kilometer squares, the lines being drawn from a single point of origin for the entire territory. By *abscissa* is meant distances measured along the axis X, to the right or left (see fig. 144), and *ordinate* is the term applied to distances measured along the axis Y, above or below the origin of coordinates.

To describe a point on the map by means of these kilometer squares it is *necessary* to proceed as follows: First designate the square by the coordinates of its S. W. angle in the order—abscissa, ordinate:

33 28

then definitely locate the object (or point) by adding to each of the kilometric coordinates the hectometric coordinates, always



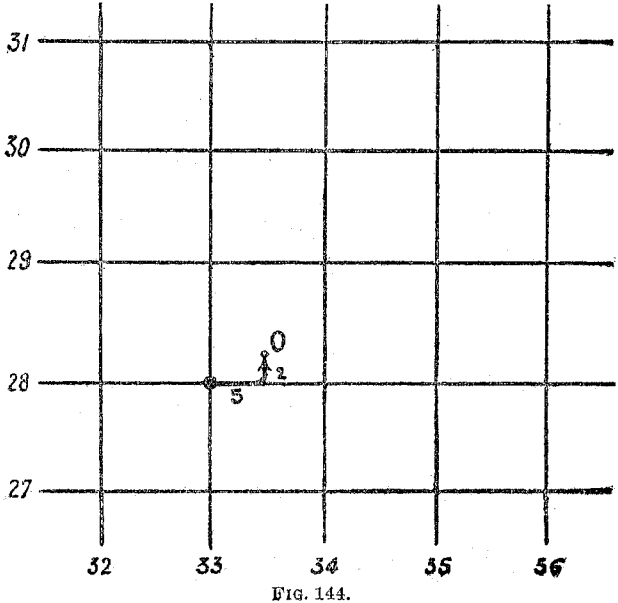


FIG. 144.

in the order—abscissa (left to right), ordinate (in the direction from bottom toward the top;

335 282

When it is not possible to make a mistake of 10 kilometers the first figure in each group may be omitted.

The objective 0 is then designated by the number 3582.

This designation indicates a region only 100 meters on a side in which the point is found, and permits its ready location on the guide chart. It is too inexact to give to artillery the exact position of a new objective precisely located by an infantry observer and not yet placed. In this case recourse should be had to a large scale plan (1/5,000 and upward), on which the position of the observed point should be indicated in pencil.

Every officer should know how: First, to locate on the guide plan any point whose coordinates are given him; second, to find the coordinates of any point whatever that is not already numbered on the guide plan. It will ordinarily be his only means of locating with some precision a point to which he wishes to attract attention.

CHAPTER XII.

TRENCH WEAPONS OF LOW POWER.

Trench artillery includes *low-power weapons* served by infantry detachments called "sapper-bombardiers," and *high-powered weapons* served by the artillery.

The principal low-power weapons in service are the *pneumatic howitzers of 60 millimeters (2.362 inches) caliber and* the *D. R. bombard.* The pneumatic howitzers include: The Brandt howitzer, model 1915; the type B howitzer, model 1916 (light Brandt); the type D. M. howitzer, model 1916 (Dormoy-Chateau).

The *note on the organization and use of infantry bombers* gives the details of the arrangements of a battery and will serve as a basis for the installation of all types of howitzers, provided they are reinforced considerably, for the protection indicated has become very insufficient.

It is especially necessary to bear in mind that *the platform is the vital part of a battery;* badly installed, it quickly becomes unserviceable. Every chief of platoon should give his assistance to the organization and solidifying of the emplacements constructed in his neighborhood. *There are never too many emplacements prepared in advance* with a view to securing to these batteries the mobility necessary to escaping reprisals and frustrating the enemy.

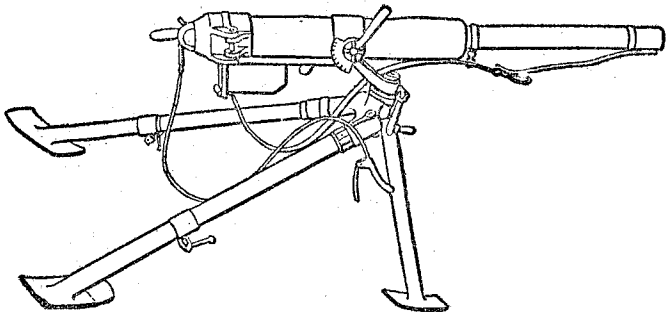


FIG. 147.—Brandt howitzer, type 1915.

1. *Pneumatic 60 millimeter (2.362 inches) howitzer (Brandt), model 1915* (fig. 147).—The compressed-air howitzer is composed of a *tube* of 60 millimeters (2.362 inches) interior diameter, the *annular reservoir*, and the *movable breechblock.*

On the part carrying the breechblock hinge are *two threaded orifices* for the coupling of air-supply tubes and also a safety plug.

Feeding is accomplished by air pumps or by tanks of compressed air. By using tanks, a rapidity of fire of eighteen shots per minute can be attained.

Personnel.—One chief of piece and observer, one gunner, one loader. Action: Give the elevation; connect the howitzer to the

pumps or tanks; take the projectile, wipe it, set the fuse, load, close the breechblock; introduce the air until the pressure gauge on the feed tube indicates the desired pressure; discharge the piece by working the sear with the finger or with the "Bowden" (pliable arrangement for controlling a bicycle brake).

Adjustment.—Variation in range is obtained by changing the elevation (angle of fire) and the air pressure in conformity with a table that is added to the equipment. The pressure varies from 4.4 to 33 pounds; the angles employed are 20°, 30°, 42°, and 60°; the angle 42° is most used. The accuracy is good. Bracketing is accomplished by changes of 2.2 to 4.4 pounds of air pressure. In enfilade fire one can almost at once get on a trench 1 yard wide up to range of 160 yards. Accuracy decreases normally with the range and very rapidly from 219 to 1,094 yards. The safety valve functions at a pressure of 33 pounds.

Recommendations and instructions.—Discharge first without a projectile to assure everything being in working order. Read very carefully the pressure gauge; if the pressure has been exceeded raise the valve or let a little air escape by slightly opening the junction of the rubber tube. Never put oil on the rubber hose joints. Weight of the piece, 48.4 pounds. Weight of the tripod, 35.2 pounds. Weight of the box of accessories with four pumps, 70.4 pounds. Projectiles, type A, model 1915, or type B, model 1916, described later.

2. *Light Brandt howitzer, model 1916.*—Same *discharge tube* and same *annular reservoir*, as the preceding, but with fixed breechblock and *loading at the muzzle.*

The piece fires at a *fixed angle* (42°) from an aluminum support to which it is rigidly attached. The entire weight is 35.2 pounds, and it is easily transportable in an attack. (Fig. 148.)

Aside from loading at the muzzle, the manipulation of the piece is the same as for the model 1915 firing at a constant angle. Assure yourself that the projectile has fallen to the bottom of the bore. Do not push it, if it has to be pushed, until you have put the pressure gauge at 0°. A graduated sector and a clamp screw assure the horizontal direction of the piece. The breechblock can be unscrewed for the purpose of extracting a projectile of improper caliber that can not be pushed to its proper seat.

3. **Pneumatic D. M. howitzer, model 1916 (Dormoy-Chateau).**—Light howitzer (33 pounds) having about the same characteristics as the preceding: Muzzle loader fires at a fixed angle

FIG. 148.—Carrying the light Brandt.

with variable pressure; very light-jointed chassis, but with little facilities for correction of direction. (Fig. 149.) Fires by pump or tank. The original feature of this engine is that the gas

check is at the muzzle; the air compressed in the reservoir by the pumps is forced into the discharge tube both in front and in rear of the projectile. When the desired pressure is attained, the gas check is unbolted by means of a lanyard; the pressure in front of the projectile at once falls, and the latter is expelled by the mass of expanding air behind it.

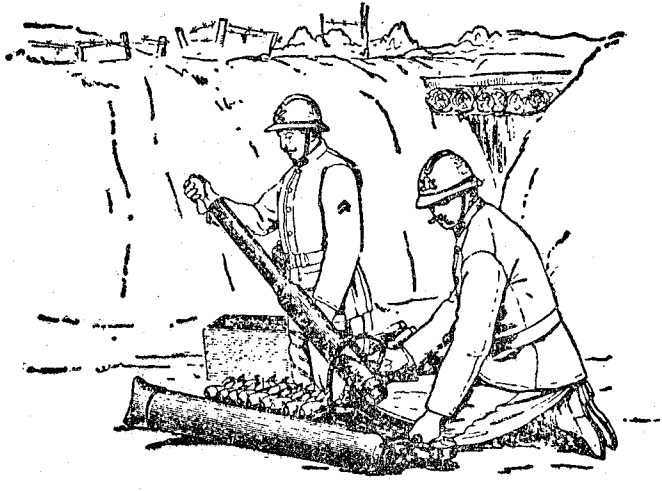


FIG. 149.—Light Brandt. Fire by tank.

The three pneumatic howitzers of 60 millimeters (2.362 inches) caliber fire the two following projectiles:

4. **Projectile, type A, model 1915.**—Cast-iron shell interiorly prepared for fragmentation, weighing 2 pounds, 1 ounce, 221 grains, of which 4 ounces, 102 grains is explosive; length, 8.26 inches; fish shape, rear feathering of four sheet-iron guide wings. Percussion fuse functioning by inertia; security assured

by a pin traversing the fuse, and that must be removed before firing. In addition, the fuse is protected by a cap that can not

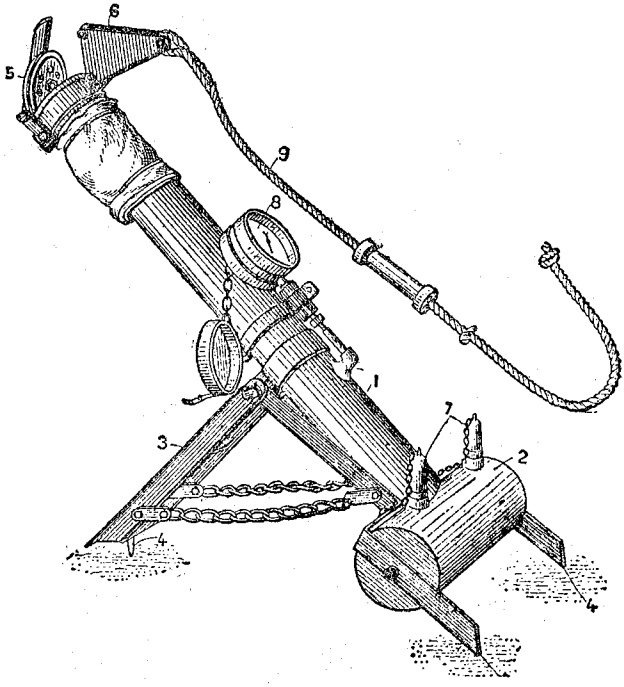


FIG 149a.—Dormoy-Chateau howitzer.

be removed, but that can be given a quarter turn after having removed the pin, in order to mask the holes in the fuse through which this pin passed. The general appearance is that of type

B (fig. 149b) somewhat elongated. Charged projectile painted blue. Practice projectile painted red.

5. **Projectile, type B, model 1916** (fig. 149b).—Shorter and lighter than type A, 1 pound, 6 ounces, 404.5 grains of which 3 ounces, 76.2 grains are of explosive. Greater range; similar effects. Safety is insured by the fact that the firing pin does not project far enough to reach the primer. But a wire is wound around the shank of the firing pin like a thread around the

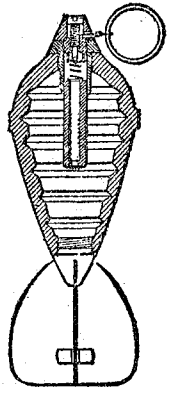


FIG. 149b.—Projectile of 69 millimeters (about 2.75 inches), type B, 1916.

spindle, and when one jerks the ring shown in the figure the firing pin turns and advances in a screw hole in the cap of the fuse and thus acquires the projection necessary to become active. Pull the ring straight so as not to break the wire. The same distinctive colors as for type A.

6. **D. R. Bombard.**—This engine is composed of a metallic base, on which are disposed 4 gun barrels, model 1874, with a breech casing. These barrels are truncated to 15¾ inches, or thereabouts, from the beginning of the chamber and close her-

metically. On each one are brazed two mandrels for the projection of the D. R. grenade. Firing is accomplished by means of a lanyard that simultaneously pulls the four triggers; eight D. R. grenades are thus projected at once. The cartridge is that of 1874, charged with smokeless powder. The range obtained is superior to that obtained by the gun (about 435 yards, as against 390 yards).

CHAPTER XIII.

VARIOUS MATÉRIEL USED IN THE TRENCHES AND IN THE ASSAULT.

1. **Wire-cutting apparatus.**

2. **Individual parapet shields** (fig. 150).—Of special sheet steel, used in the trenches either as a head shield with loophole

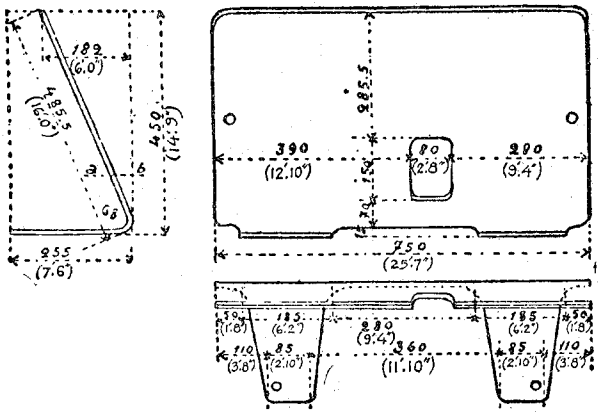


FIG. 150.—Individual parapet shield.

or as a sloping shield with the feet planted in the wall of the parapet. The type usually used has a thickness of 11½ millimeters (0.45 inch) and weighs 30 kilograms (66 pounds). It is

proof against the S. bullet at all ranges and against the S bullet inverted at 33 yards. It is not proof against the S. M. K. bullet fired at 33 yards, but this bullet is stopped when the angle of incidence exceeds 15°.

3. **Individual offensive shield** (fig. 151).—Of special sheet steel, lighter than the parapet shield. While intended to be used on the open ground it is often used in the same manner as the first. Moreover a continuous screen of these shields may be used as protection in beginning a trench. Protection against

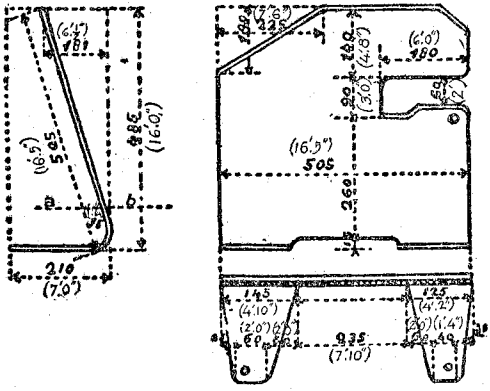


FIG. 151.—Individual offensive shield.

S. bullets at all distances; against S. bullets inverted at 55 yards. Weight, 15 kilograms (33 pounds); thickness, 7 mm. (0.27 inch).

4. **Shield of steel and sand** (fig. 152).—Proof against the German bullet at 22 yards is used to increase the protection for riflemen behind a parapet.

5. **Individual rolling shield** (Walter).—A small bombproof, mounted on two wheels, capable of being directed from inside by a man kneeling who can thus approach a shelter, wire entanglement, or an enemy's trench and fire or observe through

two holes fitted with moveable shutters. A windlass may be added, which will permit the operator to receive explosives from the departure trench and will aid him in returning. The plates protecting the head and chest furnish protection against the K. (perforating) bullet, the rest (wheels, shutters, sides, and roof) against the S. bullet, even when inverted, and against the K. bullet when the angle of incidence is under 50°. It can be transported dismounted by two men for the shield folded and one man for the wheels. (See the Instructions for the individual rolling shield, approved Feb. 20, 1916.)

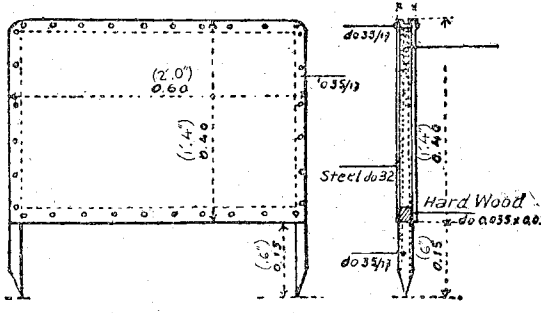


FIG. 152.—Shield of steel and sand.

6. The **Blazdix shield.**—An assemblage of two gun shields and one rifleman's shield, which will furnish protection for a machine gun and two operators. Total weight, 54 kilograms (about 119 pounds). This is completed by a wheeled truck for the machine gun, weighing 16 kilograms (35+ pounds). It is designed to become the normal means of protection for machine guns.

7. **Cired type of lookouts cover** (fig. 153).—Two models weighing 16 and 32 kilograms (35+ and 70+ pounds); plates of 8 mm. and 12 mm. thickness (0.312 and 0.47 inch).

8. **Shelter for lookouts, type S. T. G.** (fig. 154).—Three models weighing 25, 32, and 40 kilograms (55, 70+ and 88 pounds). Protection the same as for parapet shields.

9. **Demountable armored shields for observers.**—There are three types: S. T. G., Saint-Jacques, Saint-Chamond. The first two are truncated cones, made up of sides and roof clamped together. Each element weighs less than 70 kilograms (154 pounds) and is proof against the armored bullet at 33 yards and

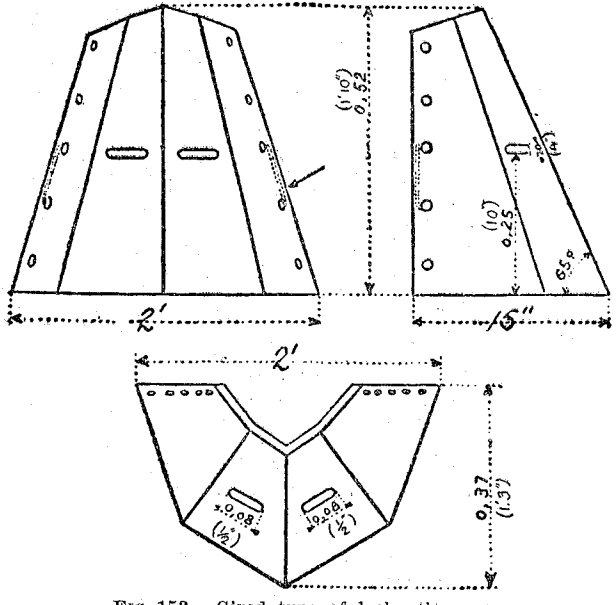


FIG 153.—Girod type of lookout's cover.

against single shots from the 37-mm. gun at 109 yards. The Saint-Chamond shield is a truncated quadrangular pyramid, the faces being joined at the edges. Each element weighs less than 70 kilograms (154 pounds) and will resist the armored bullet at 33 yards.

10. **Browning.**—See "Automatic pistols," Book III, Chapter I.

11. **Shotgun.**—The 12-gauge gun firing 0 buckshot is as formidable as the rifle up to 38 or 44 yards, and gives much

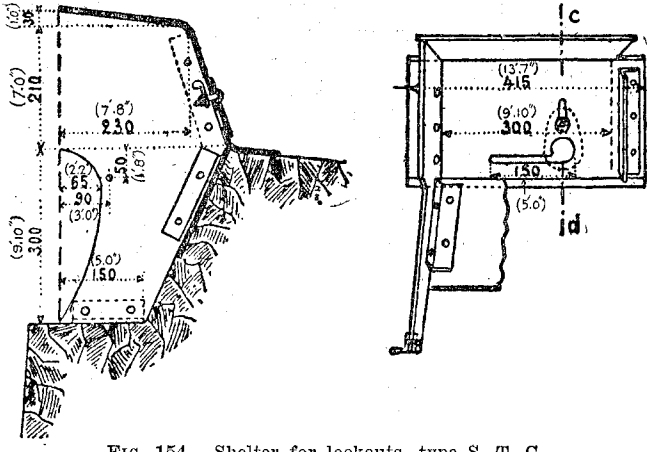


FIG. 154.—Shelter for lookouts, type S. T. G.

better chances of hitting the target in a single shot. It is the arm for night patrols and for surprises.

CHAPTER XIV.

PROTECTION AGAINST ASPHYXIATING GASES.

In the zone fixed by the commanding officer, a zone which may extend to several miles from the trenches, every one should always carry the mask M. 2 or TNH. Its use is taught

by means of frequent drills, carefully following the directions contained in the "Note of April 1, 1916, on the protection against asphyxiating gas"; this is emphasized by passing through a gas chamber; the chiefs of platoons should keep a list of all men who have not yet been through the test of the gas chamber and see that it is carried out. They should realize that they are responsible for the instruction of their men on this special point, and they should see that all the means of protection are always in perfect condition; they should insist that all their men, and particularly those who are off by themselves, should always be provided with their masks.

The following principles should be remembered:

First. The individual apparatus is the only real preventative. Its efficacy lasts several hours, after which it should be replaced.

Second. No individual apparatus is efficacious if it has not been perfectly adjusted beforehand, if it is not hermetically sealed.

Third. No apparatus is efficacious if it is not ready to be put in place quickly when the need arises. One should verify by alarms that there has been no relaxation in precaution, and that the protections prepared beforehand work quickly and properly.

Fourth. All wetting of masks is expressly forbidden.

Fifth. During a gas attack never allow the masks to be removed prematurely.

Sixth. Keep a careful watch at all times for particular manifestations on the part of the enemy indicating a gas attack (metallic noises, small balloons, etc.). When the wind is favorable redouble the attention and be ready for instant action.

The main body should be notified of any sign of unusual activity on the part of the enemy.

1. **Mask M. 2 or TNH.**—This presents the advantage of having only a single apparatus to put on to protect both the eyes and the lungs. It is made in one regular size, adjustable to the majority of heads, and two extra sizes for heads of abnormal conformation. The translucent substance does not stand washing. In the model with two separate eyepieces the translucent plate is protected by a glass plate, the inner face of which sometimes becomes covered with moisture; if it is known beforehand that the mask must be worn for some time, the glass plates should

be removed before using, after making sure that the seating of the plate that remains is sufficient to properly seal it. Every mask with a cracked plate should be replaced. The men should be warned against touching the translucent plates, which are fragile, especially after having been dampened by respiration.

2. **Draeger apparatus.**—An apparatus composed of a bottle of oxygen, a respiratory sac, a cartridge of potassium to absorb the carbonic acid expelled from the lungs, and a flexible tube with a rubber mouthpiece (two bottles and two cartridges for renewal). Breathing is done through the mouth, the nose being closed by a clip. For instructions as to use, see the note of April 1, 1916. It is serviceable for a half hour if the initial pressure of the bottle of oxygen is 330 pounds. It is forbidden to exhaust it prematurely under the pretext of testing it, or even to uncork prematurely the bottle. The Draeger apparatus is suitable for the equipment of life savers having received a special training.

3. **Eyepieces and antimoisture chalk.**—Rubber spectacles, hollowed out and forming a mask or pneumatic spectacles, are the habitual complement of the Draeger apparatus. Antimoisture chalk is employed on ordinary glass plates; it is useless on those of antimoisture glass (recognizable by being mounted in aluminum ring having serrated edges). To clean the translucent plates rub lightly the part turned toward the eye with the chalk, spread it with the finger, rub with a dry cloth, removing all signs of the chalk, until the surface becomes bright again.

4. **Tissot apparatus.**—The Tissot apparatus is a filtering apparatus and not one producing oxygen; it is a more perfect mask than the M. 2, and has no similarity to the Draeger, which it can not take the place of, and which alone makes it possible to breathe in an atmosphere devoid of oxygen. The Tissot mask is efficacious for some dozens of hours, if it has been properly taken care of. It is an apparatus of the sector, to be used in command posts, in support positions, in machine-gun shelters, in observation and signal posts; it is suitable for everyone required to remain for a long time in a noxious atmosphere not deprived of oxygen.

5. **Atomizers.**—Apparatus for collective protection: The directions for operating are generally pasted on each apparatus. For method of using, see note of April 1. Solution for the

atomizer: 9 cups of clean water, 2½ cups of carbonate solvay, or 6½ cups of crystallized carbonate, 2 cups of hyposulfite of soda. Should be prepared in advance and kept well covered and should not be poured into the atomizer until the time for using.

These apparatuses are delicate and do not work unless held properly and manipulated by men who have been exercised in their use. They will not neutralize a wave of gas, but serve during the attack and in a closed shelter to keep the canvas of the shelter wet or to absorb the gas which has filtered through the cracks; after the attack they serve to purify the air in the shelter and even in the trenches.

The solution given above freezes at a temperature of —3° The solution given below is less efficacious, but does not freeze until a temperature of —6° is reached: 15 cups water, ½ cup hyposulfite, 1 cup of carbonate solvay, 2 cups common salt.

It must be remembered that gas always has the tendency to sink, and that it is there (in hollows and low ground) that it must be fought.

6. **Protection of shelters.**—To protect a shelter, prepare in advance a panel of canvas made waterproof (parrafin, linseed oil, paint) or impregnated with hyposulfite, by which the entrance may quickly be hermetically closed. Put up as soon as possible a second canvas from 20 inches to 1 yard from the first. Keep dampened by the atomizer, worked from the interior. If nothing better is at hand, use the men's blankets.

7. **Special methods.**—The collective methods which follow give only relative protection: *Fire barrier:* The burning of dry material giving a line of high and hot flames and little smoke may, under favorable circumstances, lift the wave of gas when it arrives at the trench. If possible, two barriers close together should be prepared, one on the parapet and the other on the reverse slope. Volatile oil is more suitable than petroleum or other oily combustibles. *Isolated fires:* These can protect fairly well particular points, such as the entrance to a shelter. They are valuable for purifying the air in the trench and shelter after the passage of the wave of gas. Black-powder bombs or shells, explosive shells, machine-gun fire, throwing of incendiary grenades, etc., have no effect on a wave of gas.

8. **Protection against carbon dioxide.**—Gas from the enemy is not the only danger; carbon dioxide, produced by our own cartridges, is another in closed casemates. A single cartridge (1886) produces almost a quart of carbon dioxide. The gas escaping from the mechanism of a machine gun varies from one-sixth to one-tenth of the gas produced; the air in a shelter, 20 square meters (215 square feet), thus becomes poisoned after 250 to 300 shots, if the escape of gas takes place in the interior of the shelter.

The employment of a flash concealer also conserves gas in a shelter. It is necessary therefore to arrange the machine gun in such manner that the orifice for the escape of gas is outside the shelter or to assure a good ventilation of the shelter. It must also be remembered that the mask M. 2 and Tissot mask furnish no protection against carbon dioxide. They should never be employed as means of rescue following shell explosions or in a mine chamber; recourse must be had to the Draeger to penetrate into places devoid of oxygen or saturated with carbon dioxide.

CHAPTER XV.

EFFECTS OF PROJECTILES.

PENETRATING EFFECT OF GERMAN BULLETS.

The Germans use:

First. The S bullet, either direct or inverted; the inverted bullet is particularly efficacious when fired at short distances against homogeneous steel shields.

Second. The perforating bullet with steel core SMK, especially for fire against shields.

Table I gives the necessary thickness of different material to furnish protection against single S bullets (direct or inverted) at all distances.[1]

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[1] Greater thicknesses are required against a prolonged and regulated fire. Complete protection requires a parapet of at least 31½ inches of earth or a brick or rubble wall 14 to 16 inches thick.

TABLE I.

Nature of obstacle.	Thickness.
	Inches.
Clay	28
Wet earth, not packed	20
Wet earth, packed	16
River sand	12
Oak wood	20
Spruce	28
Brick and rubble walls	9
Manure	40-50
Packed snow	100

Table II gives the thicknesses and composition of certain systems of simple shelters which will resist the fire of the S bullet, either direct or inverted, even at short ranges.

TABLE II.

Character of protections.	Total thickness in inches.
Ordinary soft steel, in one plate or several plates placed together (S direct only)	½+
Ordinary soft steel, three plates of ⅛ inch separated by intervals of ¾ to 1¼ inches	[1] 2.362-2.786
Ordinary sheet iron and wood, oak planks, 1¼ inches thick between two plates of ½ inch	[2] 2.16
Pine planks, 2.36 inches thick, between two ¼-inch plates	[2] 2.75
Two oak planks 1.06 inches each between two plates, the front one 0.093 inch and the rear one 0.157 inch thick	[2] 2.375
Ordinary sheet iron and sand, 1.575 inches of sand or fine gravel between two plates, the front one 0.098 inch and the rear one 0.157 inch	[2] 1.83
Wood and sand, 3.937 inches of sand between two oak planks 1.06 inches each, or a pine plank of 0.984 inch in front and one of 2.36 inches in rear	6.30-7.87

[1] One-half being metal. [2] About.

NOTE.—When a shelter is composed of several plates of metal, with or without a filling between, the thinner plate must always be placed in front.

Experiments made firing against special steel armor plate have given the following results:

S bullet, direct: Plate of .197 inch can be perforated up to 174 yards; plate of .275 inch resists penetration beyond 27 yards; plate of .315 inch resists at all distances.

S bullet, inverted: Plate of .275 inch can be perforated up to 55 yards; plate of .315 inch can be perforated up to 27 yards; plate of .394 inch can be perforated up to 22 yards.

SMK perforating bullet: To resist the SMK perforating bullet at 55 yards, under the normal angle of incidence, a thickness of .55 inch of special steel is necessary. But the resistance of steel plates increases rapidly with the angle of incidence of the bullet. Table III gives the angle of incidence beyond which protection is obtained, for different thicknesses, against perforating bullets fired at a range of 33 yards.

TABLE III.

Thickness of plates of special steel.	Angle of incidence.
	°
.275 inch to .2945 inch	40
.315 inch to .3345 inch	30
.394 inch to .4135 inch	20
.433 inch to .473 inch	15

These conditions are practically satisfied with the different types of individual and parapet shields.

EFFECTS OF ARTILLERY FIRE.

TIME-FUSE PRACTICE.

(*a*) *Shrapnel.*—The sheaf of shrapnel balls (fig. 155) is a solid cone with a small dispersion of only about 15° to 20°. The penetration of the bullets in different materials is much less than that of rifle bullets.

In the waiting position the defenders close up to the interior slope of the parapet of a trench have nothing to fear from shrapnel.

In the firing position the upper part of the body is exposed. In order to be able to fire while under shrapnel fire, it is necessary to furnish the parapets with special arrangements which protect the head and shoulders of the firers, but which will not reveal the presence of the trench at a distance.

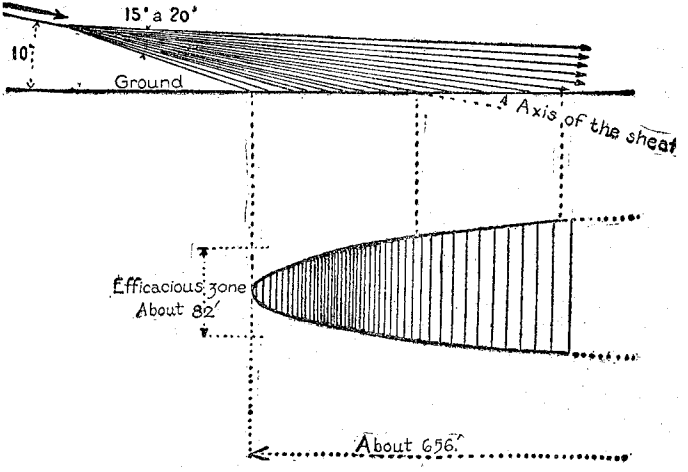


FIG. 155.—Sheaf of shrapnel bullets.

(*b*) *Explosive shells.*—These shells give a hollow and very open sheaf. The fragments are numerous and irregular; they have a high initial velocity but lose it rapidly; their penetration is slight.

When the shell bursts at a good height the result is a sort of vertical blow, like that of an ax, the effect being considerable but of small extent.

The explosive shell of a German field gun can reach men defiladed up to 60° by the crest of the cover. (Fig. 156.)

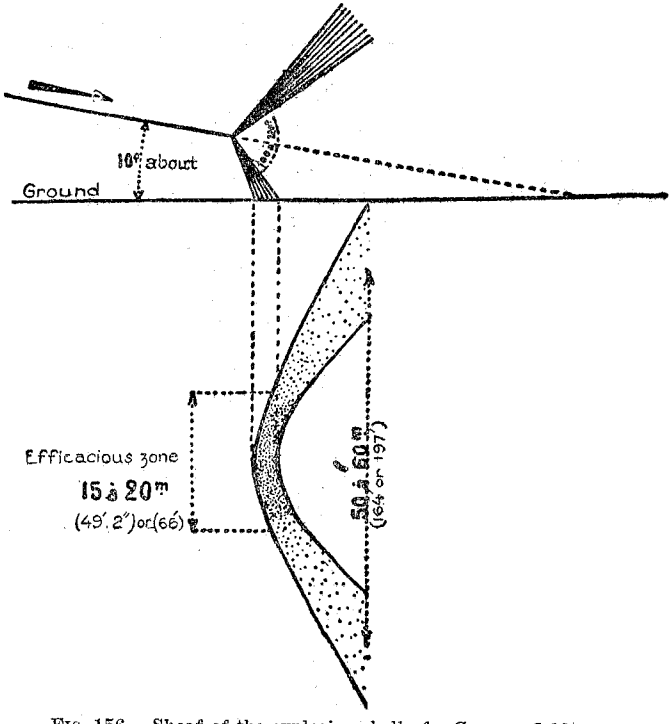


FIG. 156.—Sheaf of the explosive shell of a German field gun.

The projectile of the light howitzer of 105 mm. (4 inches), whose sheaf is even more open and whose trajectory is more curved, even sends fragments to the rear. (Fig. 157.)

As a result, even in the waiting position, the defenders of a trench may be reached by this fire if they are not protected by some overhead cover.

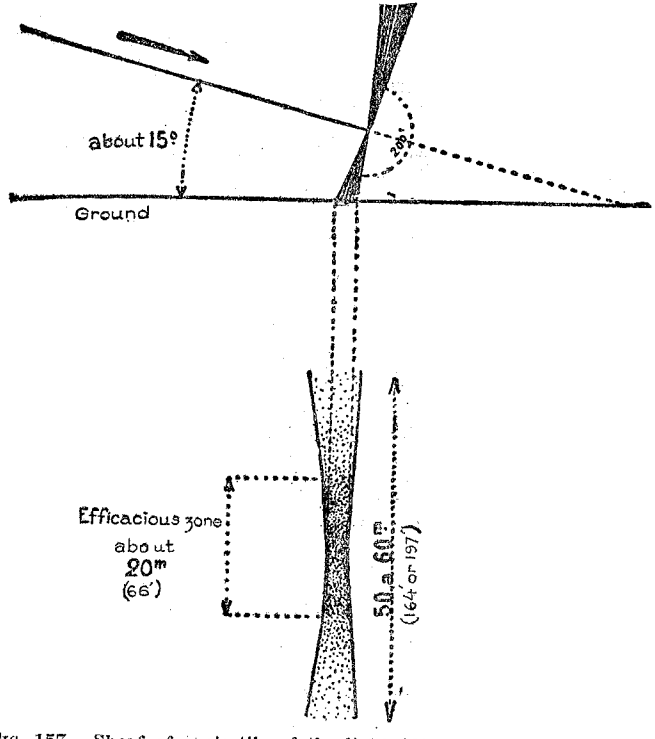


FIG. 157.—Sheaf of projectile of the light 105 mm. (4-inch) howitzer.

Moreover, every trench should be provided with a parados against the fragments flying to the rear. However, it must be remarked that to be efficacious, the fire requires great precision in range and elevation and consequently good observation of the shots, without which, to obtain appreciable effects, a great expenditure of projectiles will be required.

PERCUSSION FIRE.

A thickness of 2½ to 3 meters (8½ to 10 feet) of ordinary earth is sufficient to withstand a prolonged fire with percussion shell from the German field gun.

Field artillery can certainly open breaches in trench parapets, but the complete destruction of any considerable length of parapet is only possible with an enormous expenditure of ammunition.

The action of the shell of the 105 mm. (4 inches) and of the 15 cm. (6 inches) is more powerful; it is sufficient to perforate up to about 2,000 meters (2,188 yards) the covering of a light shelter (layer of logs 0 m. 20 (8 inches) covered with 0 m. 30 (1 foot) of earth; but it is not efficacious against the roof of a reinforced shelter composed of two layers of logs and two layers of earth of the above thickness

Table IV indicates the thickness necessary to resist field artillery fire:

TABLE IV.

Kind of fire.	Earth.	Brick masonry.	Wooden roofing.
Field gun:			
Bullets and fragments	16 to 40 inches	9 inches	3 inches.
Percussion shell	3 feet 4 inches to 6 feet 8 inches.	3 feet 4 inches	Do.
Light howitzer:			
Bullets and fragments	3 feet 4 inches	9 inches	6 inches.
Percussion shell	10 feet to 14 feet	6 feet 8 inches [1]	Do.
		3 feet [2]	Do.

[1] Direct fire. [2] Plunging fire.

ARTILLERY FIRE AGAINST WALLS AND HOUSES.

In walls of usual thickness percussion shrapnel and explosive shell make a hole of about 0 m. 40 (16 inches) and burst after having gone through the wall. The first, on account of its narrow sheaf, causes less loss than the second to the defenders behind the wall. Men behind a second wall are safe from danger. The destruction of a considerable length of wall requires a large expenditure of ammunition and an accurate fire.

The heavy 15-centimeter (6 inches) howitzer and the heavy caliber guns cause considerable damage to houses. Besides the material effects produced by the shock of the projectile or by the bursting of the shell they are susceptible of destroying by the blast the upper stories of houses, but the cellars generally remain uninjured.

ARTILLERY FIRE AGAINST WIRE ENTANGLEMENTS.

About 150 explosive shells from a field gun are sufficient to make a breach of 5 to 10 yards in length in a wire entanglement 20 to 25 yards wide at 3,800 yards. The same effect is produced by 75 shells of the 155 mm. (about 6 inches). At 6,600 yards double the number of shells are required to produce the same result. An explosive shell of the 75 mm. (3 inch) gun destroys from 10 to 12 square yards of the Brun spiral.

CHAPTER XVI.

INFORMATION CONCERNING THE "75."

Rapid-fire gun, caliber 75 mm. (3 inch) for light batteries and horse batteries. Gun is handled by six cannoneers. Carriage with shield, immovable during fire. Has a hydropneumatic recoil brake which brings the gun back to its original firing position. Weight of gun alone, 460 kilograms (1,015 pounds). Piece in battery, 1,140 kilograms (2,514 pounds). Weight of caisson (96 rounds), 1,200 to 1,300 kilograms (2,646 to 2,866 pounds), according to the kind of ammunition carried (shell or

shrapnel). Capacity of limber, 24 rounds. Supply for each gun of the battery, 312 rounds. Limit of graduation of the sight, 6,000 yards. Extreme range, 9,300 yards.

Front covered by a battery at medium ranges: Firing with time fuse without sweeping, 110 yards; firing with time fuse sweeping, 220 yards; firing with percussion fuse, width of obstacle of 27 yards.

To set and release the brakes.—When firing (in firing position) the carriage is secured on the ground by the trail spade and the wheel brakes, which consist of two metal plates or shoes, fitted on their underside with a spade parallel to the axis of the carriage. Before firing it is necessary to place these plates on the ground and mount the wheels on them by moving the piece slightly to the rear. An arrangement of a pivoting lever, engaging with the teeth of a rack placed under the carriage, allows the raising and lowering of the trail. This operation is called setting the brakes. It is then secured to the ground at three fixed points and is ready to fire. When the piece is in the firing position, in order to move it it is necessary to release the brakes. Circumstances may arise when an officer or a noncommissioned officer of infantry will have to move a piece by hand, or even to remove it and join it with its limber or other vehicle. He will not be able to do this unless he has learned how to *release the brakes;* the immovable piece will resist all his efforts and ingenuity. Every officer should take advantage of the presence of a battery near him to learn practically—first, to release the brakes; second, to dismount and to disable a "75."

To disable.—A strong steel bolt called a key unites the piece and its recoil check. If this key is removed, the piece becomes useless. If, besides this, a projectile is fired, the gun, not being held securely, is torn from the carriage under the influence of the recoil and is thrown to the ground some distance to the rear. An officer or a noncommissioned officer of infantry may have to take this action at a critical moment. Another method of disabling a piece has been explained in the chapter on explosives.

PART IV.

MISCELLANEOUS INFORMATION WHICH THE CHIEF OF PLATOON SHOULD POSSESS.

CHAPTER I.

PRINCIPLES.

The military education of the commander of any grade is based upon a few principles, which should be known to all. These principles are as follows:

ENERGY.

Energy is the most important of soldierly qualities. From it spring bravery, fortitude, self-sacrifice, discipline, and devotion to duty. It is the energy of the leader and of his men which enables them to carry a fight to a finish and which brings forth the highest acts of heroism. When the leader is considering various courses of action he will be sure to be right if he decides upon the most energetic.

UNITY OF ACTION.

In order to defeat the enemy we must strike hard, as hard as possible and all together. One can never be too strong, either in attack or defense. A good chief of platoon gets all of his men into action and leaves none of them idle during critical moments. If he loses touch with adjoining troops and has no orders, he will go wherever fighting is going on and place his platoon at the disposition of the commander.

SURPRISE.

An attacking force will attain the greater results in proportion as its action is unexpected by the enemy. The advantage of surprise should always be sought for. Surprise is obtained by a combination of two essential conditions—*secrecy* in preparation and *celerity* in execution.

SECURITY.

On the other hand, we must avoid being surprised. It is a fundamental duty of the commander to provide for the security of his men in every direction in which the enemy may appear.

The above principles have been true in all ages. It is difficult to follow all of them, but when, in exceptional cases, we are compelled to violate one of them, it should be done only for the purpose of applying the others more perfectly.

CHAPTER II.

NOTES ON ORGANIZATION.

THE ARMY CORPS.

An army corps consists of the general headquarters, the troops, and the administrative departments. The headquarters includes the general officer commanding the corps, staff, an artillery staff, an engineer staff, and the commanders or heads of the various administrative departments (supply, sanitary, veterinary, pay, post office, provost, and judge advocate). The troops include the infantry divisions, the corps artillery (which includes trench artillery, light artillery, and heavy artillery), the corps cavalry (a regiment), some companies of corps engineers, an aero squadron, and a balloon company.

The administrative departments are those of the following organizations and services: The artillery park, including the artillery and the infantry ammunition trains; the engineer train, including the corps engineer park, the searchlight sec-

tion, and the bridge train; the military telegraph unit; the supply train (including the motor transport company for the supply of fresh meat and the herd of live animals); the sanitary train (one group of corps litter bearers, two sections of motor ambulances, and four ambulances); the pay department; the post office department; the military police; the department of military justice; and the veterinary service and remount depot.

THE INFANTRY DIVISION.

An infantry division also consists of the headquarters, the troops, and the administrative departments.

The headquarters includes the general officer commanding the division, his staff, the general commanding the infantry, the artillery commander, the commander of the engineers of the division, and the chiefs of the administrative departments, viz, supply, sanitary (one group of divisional litter bearers and two ambulances), pay and post office, military police, and military justice (court-martial of the division). The troops are: Three regiments of infantry or two brigades of two regiments each, the divisional artillery (including one regiment of light artillery, heavy artillery, and trench artillery), the divisional cavalry and some companies of divisional engineers. The division has a motor department (where bicycles also are repaired); a divisional artillery park, including a department for repairing machine guns; a telegraph unit; a supply train; a department for the supply of fresh meat and a park of beef on the hoof. It also includes the depot of the division, which has one infantry company for each battalion in the division. These are the fourth companies of these battalions, which remain behind with their officers, noncommissioned officers, men, and vehicles, but which continue to form part of their organizations, from which they are regarded as detached. The command of the group of companies pertaining to each organization is ordinarily exercised by the senior captain present.

THE INFANTRY BRIGADE.

The infantry brigade is not an administrative unit. It includes a general officer commanding the brigade, a military

staff, and two regiments of infantry. It does not exist in a division of three regiments.

THE INFANTRY REGIMENT.

The infantry regiment includes the regimental staff, one headquarters company, three battalions (normal organization), one platoon of 37-mm. (1.5-inch) guns (one gun for each battalion) attached for rations only to the first machine-gun company, the combat trains, and the field train.

The regimental staff.—The regimental staff includes the colonel, 1 lieutenant colonel or major (assisting the colonel), 1 captain (adjutant), 1 telephone officer, 1 lieutenant commanding the platoon of sappers and grenadiers, 1 color bearer, 1 utility officer (who commands the combat trains when they are assembled), 1 supply officer (who commands the field train of the regiment), 1 regimental surgeon (chief of the sanitary service), 1 chief musician, and 1 information officer (who is detached from a company).

The headquarters company.—The headquarters company includes the colonel's clerks and cyclists (one of whom is messenger for the regimental surgeon); the assistants of the supply officer, including 1 warrant officer; 1 sergeant major, 2 sergeants, 1 sergeant and 5 men (butchers), cyclists, and teamsters; the assistants of the quartermaster, including 1 sergeant major artificer, 1 corporal clerk, some clerks and teamsters; the assistants of the telephone officer, including a telephone detachment of 3 sergeants, 8 corporals, 40 privates (8 stations); a signal detachment of 1 sergeant, 1 corporal, and 8 signalmen; 1 platoon of sappers and grenadiers, viz, 1 noncommissioned officer (commanding the section), trained sappers, including 1 corporal and 12 privates, the pioneer detachment, including 2 sergeants, 4 corporals, and 48 pioneers, the bombing section of 1 sergeant, 3 corporals, and 24 grenadiers; 1 assistant chief musician, 1 drum major, and 38 musicians; 1 chief armorer and 3 armorers; 1 veterinarian (for each brigade), 1 farrier corporal, 5 farriers and 2 saddlers; 1 litter-bearer sergeant; the postmasters (1 postmaster and 1 assistant for each battalion); the mounted scouts (2 sergeants, 2 corporals, and 8 troopers); the noncommissioned officers belonging to the headquarters company; the

cooks; laborers; the orderlies of the officers of the regimental staff; 1 tailor; 1 shoemaker.

NOTE.—The sergeant major is a company noncommissioned officer almost the equivalent of the first sergeant in the United States Army.

THE INFANTRY BATTALION.

A battalion consists of a staff, a noncommissioned staff, three companies, and one machine-gun company. The fourth company is usually detached and remains at the depot of the division.

The staff includes the battalion commander, 1 captain (adjutant), and 1 surgeon.

The noncommissioned staff is rationed with the first company of the battalion. It includes 1 sergeant (assistant of the battalion commander); 1 cavalry sergeant (attached); 1 assistant surgeon; 1 artificer sergeant (commanding the combat train of the battalion); 1 chief bugler (a corporal); 1 chief litter bearer (a corporal) and some litter bearers; 5 signalmen (one of them a corporal); 3 cyclists (one of whom is the surgeon's messenger or liaison agent); the drivers of the 3 wagons belonging to the battalion (baggage wagon, medical-supply wagon, and caisson); and the orderlies of the 3 officers.

The litter bearers number 16 or 28, depending upon whether the regiment has or has not a band.

THE INFANTRY COMPANY.

The company consists of a captain; 3 lieutenants or second lieutenants; 1 warrant officer (adjutant); 1 first sergeant (sergeant major); 1 quartermaster sergeant; 8 sergeants; 1 quartermaster corporal; 16 corporals; 4 drummers or buglers; 1 soldier of the medical corps (in the first company he is a corporal); 1 cyclist; 1 tailor; 1 shoemaker; the drivers of the three wagons of the company; 4 sappers and pioneers; 4 orderlies; 2 signalers; and the soldiers of the company (grenadiers and riflemen), divided into 4 platoons.

MACHINE-GUN COMPANY.

Machine-gun companies are of two types, either on wheels (gun carriages and caissons) or alpine type (all pack mules).

A company consists of the captain; 2 lieutenants; a sergeant in charge of liason; a noncommissioned officer accountant; a supply corporal; a range finder; an armorer corporal; a medical corps private; a cook; 3 or 4 firing platoons with their ammunition; and the company combat train.

Firing platoon.—Each platoon has a lieutenant or a sergeant in command; a noncommissioned assistant to the platoon commander; 2 corporals, each commanding a machine gun; two gunners; 2 loaders; 2 assistant loaders; an armorer; and a liaison agent.

Ammunition supply.—Two supply corporals; 4 ammunition carriers for each platoon, the carriages or mules for the machine guns and ammunition. For a company of 4 platoons there will be 16 light carriages, 8 for the guns and 8 for the ammunition, or 36 pack mules.

Company combat train.—Two corporals, and, theoretically, 1 caisson or 6 mules for each platoon. But since the adoption of 8 automatic rifles per company the combat train of the machine-gun company has been reduced to 2 caissons for 3 sections and 3 caissons for 4 sections. As soon as every infantry company has been supplied with 16 automatic rifles, the machine-gun companies will lose another caisson apiece. The caisson holds about 25,000 cartridges on rigid strips and a few spare ammunition cases.

The 37-mm. gun platoon.—This platoon is rationed with machine-gun company No. 1. It includes 1 lieutenant and 1 liaison agent (both mounted on bicycles), and has as many guns as there are battalions in the regiment. Each gun has a detachment consisting of 1 sergeant, 1 corporal, 1 gunner, 1 loader, 2 ammunition carriers, 3 cannoneers (2 with ammunition cart and 1 teamster, not mounted). The combat train of one gun or of one platoon of two guns is one caisson with 2 mounted drivers; for a platoon of three or four guns, 2 caissons and 4 mounted drivers.

The combat train.—The combat train is commanded by the regimental supply officer and includes:

For the regiment, 2 light tool wagons; 3 wagons of materials (telephones, wire, sandbags, and bombs); 6 water wagons; 1 ambulance; 1 medical supply wagon (carrying wheel litters

and gas masks); 2 forges; 2 ration and baggage wagons; 1 kitchen; and the led horses.

For each battalion, 1 medical supply wagon; 1 ration and baggage wagon; and 1 four-horse ammunition wagon carrying 25,000 rounds of small-arms ammunition and 48 haversacks. The ammunition wagon of the detached company at the depot of the division carries 14,000 rounds of small-arms ammunition and 24 haversacks. The ammunition transport is doubled when each company has 16 automatic rifles.

For each company, 1 ammunition wagon, 1 ration and baggage wagon, and 1 rolling kitchen.

For each machine-gun company, some ammunition wagons; 1 ration and baggage wagon; 1 rolling kitchen; and the ammunition wagons belonging to the 37-mm. guns.

The combat train may be divided into two echelons:

The first echelon is commanded by the artificer sergeant major, and includes the medical supply wagons, the filled ammunition wagons, the wagons of tools and materials, and the led horses.

The second echelon is commanded by the utility officer, and includes the ration and baggage wagons, the water wagons, the kitchens, the forge, and the empty ammunition wagons.

The field train.—The field train is commanded by the supply officer and consists of three sections. Two sections of 5 wagons each bring up and distribute alternately one day's rations to the regiment (each of these sections is commanded by a sergeant). One reserve section of 3 wagons is commanded by the sergeant major of the field train. The field train also includes 2 forage wagons, 2 wagons or 1 three-horse van carrying oats, 3 fresh-meat wagons, and 6 led horses.

MISCELLANEOUS DETAILS OF INFANTRY ORGANIZATIONS.

The medical corps detachment of the battalion is ordinarily with the battalion medical supply wagon, but when a company is detached its quota of the medical corps detachment goes with it.

The chief litter bearer (corporal) is with the medical-supply wagon of the battalion.

Litter bearers are ordinarily with the companies to which they belong, but when the battalion goes into action they are assembled by the chief litter bearer.

The drummers and buglers ordinarily act as liaison agents of the captain.

The artificer sergeant (of the battalion) is in charge of the ammunition wagons of the battalion so long as they are full. When they are emptied and sent to the rear he joins the artificer sergeant major (of the regiment) in order to supervise the ammunition supply from the ammunition train. (See "Ammunition supply," Book IV, Chap. XI.)

The mounted orderlies are assembled with their horses, by battalion or by regiment, in rear of a designated unit.

The specialists of the company: In addition to those already mentioned, the companies provide the following specialists:

Liaison to the company commander. See "Company formations," Part II, Chapter VI.

Liaison to the battalion commander. Each company sends to the major a supply sergeant or supply corporal, and generally also a squad of messengers composed of one corporal and four riflemen. The machine-gun company sends the sergeant in charge of liaison.

Pigeon caretakers, when they are necessary, are also detailed from the companies.

Observers and signalers: There are two signalers in each company. For substitutes they have two observers (riflemen), who, like themselves, are trained by the telephone officer. In addition, in each company 1 officer, 2 sergeants, the liaison agents, and at least 6 substitutes must be able to send and receive the Morse code.

Specialist officers: The company may include in its effective strength the grenadier officer of the battalion, the automatic rifle officer of the battalion, or the intelligence officer of the regiment. The two first-named remain in charge of their platoons. A sergeant is detailed to accompany the battalion commander as intelligence sergeant.

CHAPTER III.

DISTINCTIVE INFANTRY TACTICS.

The principal characteristics of infantry are the following:

1. *Infantry, unsupported, can not attack lines of obstacles covered by fire and provided with accessory defenses.*—When an attacking line is checked by defensive lines which are intact and occupied by the enemy, reinforcing it by reserves has no chance of success, and the attempt to do so will only increase the losses. An attack should never be launched unless it is preceded and accompanied by effective artillery fire. Men can not fight machines.

2. *Infantry can hold ground tenaciously.*—Intrenching tools enable the soldier to protect himself against attacks. The power of modern arms (rifle, automatic rifle, grenade, rifle grenade, and machine gun) gives an almost complete certainty of stopping an attack which is not prepared by artillery fire. The employment of obstacles which hold the enemy under frontal and especially under enfilading fire enables us to be satisfied with reduced fields of fire. Infantry can hold, close to the enemy, positions which appear at first sight to be unfavorable. If a few hours are available for entrenching and placing obstacles, it can be sure of holding ground which it has gained.

3. *Infantry becomes exhausted quickly.*—The advance in a war of position is subject to all sorts of difficulties. In the first place the cutting up of the ground by trenches, communicating trenches, tunnels, etc., makes it extremely difficult to keep troops in hand. And besides the incessant shocks produced by artillery fire, machine-gun fire, grenades, etc., contribute to the disorganization of units. We should avoid, both at the beginning and during the course of an attack, making the firing line too dense. When gaps occur in it they should be filled carefully, avoiding the "bunching," which increases disorder and losses. When a body of troops has been hammered hard, they should, if practicable, when a fresh effort must be made, be relieved by a body of fresh troops. In this way their complete disorganization, with no compensating gain, can be avoided.

4. *Infantry must not maneuver in dense formations.*—In the zone swept by artillery fire columns of squads and lines of platoons are absolutely prohibited.

5. *The morale of infantry is extremely important.*—An operation can not be prepared solely from the material standpoint. A moral preparation is indispensable. This preparation is secured by the commander in the visits which he makes daily to his men.

CHAPTER IV.

RIFLE FIRE.

The conduct and execution of fire differ according to the tactical situation of the troops who are delivering it, depending upon whether they are defending an entrenched line, attacking an entrenched position, or engaged on open ground either in attack or defense. Objectives differ in character, in the manner in which they appear, and in vulnerability. Consequently the manner of delivering fire continually changes. Each new condition should be met in an appropriate manner.

However, there are certain characteristic features which may be regarded as the *principles of rifle fire:*

1. The fire is always delivered by *groups.* The platoon is, as a matter of fact, too large a unit and possesses too many kinds of arms to be well controlled throughout by its chief directly. Intermediaries are necessary to transmit his orders. The leaders of sections and of squads perform this function and actually direct the fire in accordance with the orders of the platoon commander.

2. The fire is always *from the magazine.* In a fire fight of any kind the targets show themselves for short periods only, and during these periods it is important to deliver as great a volume of fire as possible in order to obtain the maximum of effect.

3. *Fire discipline* is a necessity of the first importance. Fire discipline permits the concentration of fire and secures surprises. It prevents waste of ammunition and permits sustaining the fight. It preserves the morale of the men and keeps them in hand for subsequent efforts. It consists essentially in securing

an immediate opening or cessation of fire at the command of the leader. All officers and noncommissioned officers, especially the file closers, must exert themselves to attain it. Volley firing is an excellent means of steadying a body of troops whose fire has weakened or become disorganized.

4. The results obtained depend above all—

(*a*) *Upon the coolness of the commander.*—It is only by remaining cool that the commander can obtain the highest degree of fire discipline among the riflemen of his platoon; that is, to be able to break off and resume firing at will. Fire discipline can not be maintained except by a leader who is master of himself.

(*b*) *On the steadiness and skill of the men.*—Collective fire is effective only when it is an aggregation of accurate shots delivered with correct sight adjustment. It is dependent upon the individual training of the men firing.

FIRE OF THE PLATOON IN DEFENSE OF AN ENTRENCHED LINE.

The chief platoon organizes beforehand squads of riflemen under command of sergeants or corporals and assigns to them parts of the trench best adapted to its defense. All dispositions are provided for in advance by orders given to be followed in case of alarm. *In daytime* the fire usually employed is "fire at will." However, volleys are frequently used, as they shake the morale of the enemy and give confidence to our own men. *At night volley firing is the rule.*

THE PLATOON IN A GENERAL ATTACK AGAINST AN ENTRENCHED POSITION.

In an action of this kind the rule is to fire but little, as its purpose is to gain as soon as possible the objective designated. Nevertheless, the advance may be impeded by local resistance from certain points (by groups of riflemen, machine guns, etc). This resistance must be crushed as quickly as possible, and the chief of platoon will direct a rapid fire by his entire platoon upon such points in order to be able to resume the advance.

RIFLE FIRE IN WAR OF MANEUVER.

In defense.—Acting defensively in open country, the platoon is not required, except in rare cases, to deliver fire at long ranges; distant targets are more effectively taken care of by automatic rifles and machine guns. Moreover, it is often better to delay opening fire in order to obtain later a more effective fire upon an advancing enemy. The effect of fire is greatly increased if it comes *as a surprise.* In order to obtain this effect it is necessary that the preparation (the designation of the target and of the range) should be as complete as possible in order that the first burst of fire shall be certainly destructive. The chief of platoon has the sights set, conducts his men to the firing position, and does not open fire until all the men have seen the target and have had time to take accurate aim.

The range.—In a defensive action the chief of platoon seeks to obtain while waiting a knowledge of the ranges to prominent objects in the foreground, in order that he may avoid making considerable errors in the designation of the range when his target appears. He makes use of the map or has the distances paced, or makes inquiries of neighboring troops who have range finders.

Designation of the target.—In order to designate a target which can not be described easily, the chief of platoon selects a reference point which is plainly visible and which can be indicated without danger of mistake. He then states how many fingers' or hands' breadths the desired target is to the right or left of the designated reference point.

In the attack.—Targets can seldom be seen clearly; we guess where the enemy is rather than see him. We must watch closely and try to discover him, and must notice every movement in the general direction of the designated objective. The absolute rule in the attack is to alternate firing and advancing. The platoon does not fire except to prepare for a rush, or, if it can not advance, it fires to cover the movement of a neighboring unit.

However favorable the opportunities may be for firing, we must not fire if we can advance. Fire whose effect is not immediately utilized is wasted.

Fire is ordinarily conducted by sections, rarely by squads. The opening of fire should be instantaneous.

Rate of fire.—The normal rate of fire is eight shots per minute.

Effect of the ground.—A shot group G will have beaten zones AB, AC, and AD of different extent, depending upon the angle of slope. And the zone of grazing fire which precedes the beaten zone is greater on AD than on AC or AB.

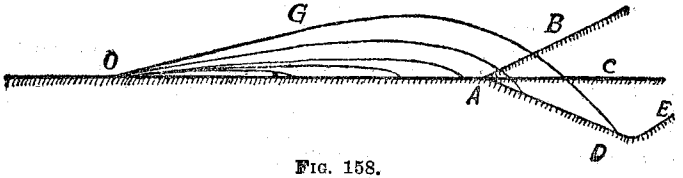


FIG. 158.

It is apparent that reserves posted on the *slope* AB may, if they can find concealment, be in a less dangerous position than if they were on the *reverse slope* AD and screened from the view of the enemy. The occupation of a second slope E unites both advantages with respect to fire from O.

FIRING ON AEROPLANES.

Firing on aeroplanes is prohibited in the case of individual riflemen and of troops who have been assigned an objective to reach or to fire on, which they should not lose sight of. It is done only *under the orders of an officer.*

Fire should not be opened until it is certain that the aeroplane is a hostile one and it is known that there are no groups of our own troops between the distances of 1,100 and 4,400 yards (zone of the fall of bullets) in the direction of fire. The fire is conducted by platoons and with deliberation. In a column of troops and in the supports of the first line platoons are designated beforehand for this purpose and these platoons keep a constant lookout for hostile aeroplanes.

Rules can only be given in the case when the aeroplane passes directly overhead or nearly so.

Rules for firing on aeroplanes.—(Note: This rule as given applies to French rifle.) While the aeroplane is approaching use an elevation of 2,600 yards. Face toward the approaching aeroplane and open fire when it appears to be at a vertical angle of 45°, aiming directly at it. Continue firing with the same elevation until the aeroplane is just about to pass the vertical. Then face about toward the aeroplane and lower the sight leaf forward. After the aeroplane passes use an elevation of 300 yards, aim at first about 10 aeroplane lengths in front of the aeroplane, and keep this up for about 30 seconds, then aim directly at it and continue firing until it reaches an apparent vertical angle of 45°. An application of these rules will bring the sheaf of bullets upon the aeroplane once while it is approaching and twice after it passes. It is useless to fire on an aeroplane which covers a visual angle less than 8 mils. It is forbidden to fire on an aeroplane which is landing.

ESTIMATION OF DISTANCES.

Pacing.—Everyone should know the number of strides he takes in pacing 100 yards. Fewer mistakes are made in counting strides (that is to say, the number of times the left foot comes to the ground) than in counting single paces. After counting the number of strides corresponding to 100 yards, a mark is made on a piece of paper or a pebble is placed in the pocket and counting is commenced again, 1, 2, 3, etc. To turn into yards the number of strides over the last hundred recorded it will be close enough to double them. For instance, if we have 6 pebbles and 36 strides over, it may be put down as 672 yards. This method is useful in making sketches of positions or road sketches.

Estimating distances by eye.—By *personal* observation we learn, for example, that at about 400 yards we can not make out a person's face but can still distinguish his arms, that at 650 yards we can distinguish the files of a column, and that at 1,100 yards we can distinguish a horse from the wagon which he is pulling, etc. We must be on our guard against errors which come from changes of light, from the character of the background, from dust, from the different appearance of uniform and variegated ground, from folds in the ground, etc. This method

is not very accurate, but we can get better results by having a number of trained observers estimate the range and taking the mean of their estimates.

Estimating distances by sound.—Sound travels about 1,100 feet or 366 yards per second. By training ourselves to count in a regular cadence, say, up to 10 in three seconds, we have a means of gauging the interval which elapses between seeing the flash of a gun and hearing the report and consequently of computing its distance from us. This method is unreliable when the projectile travels faster than the sound.

CHAPTER V.

TACTICAL EMPLOYMENT OF MACHINE GUNS, AUTOMATIC RIFLES, GRENADES, TRENCH WEAPONS, AND 37-CALIBER (1.5-INCH) GUNS.

The chief of platoon has some men armed with automatic rifles and some grenadiers under his immediate orders; his work is intimately associated with that of platoons of machine guns and batteries of low-power trench weapons in his vicinity; and he may even have one of these platoons or batteries placed under his orders to enable him to fulfill an offensive or defensive task assigned to his platoon. It is necessary, therefore, that he should know the best methods of using these weapons.

1. Machine Guns.

Characteristics.—Machine guns are preferable to infantry whenever fire alone is sufficient for the purpose. Infantry is indispensable when both fire and movement are required.

The machine gun delivers a very effective grazing fire up to 900 or 1,100 yards; its fire is effective upon important targets at ranges over 1,100 *provided the range is accurately estimated.*

The two chief uses of machine guns are in *flank fire* and *surprise fire.* The sheaf of bullets is dense and deep but narrow; its maximum effect will be obtained upon a target having a

narrow front and considerable depth—for example, *a thin line taken in flank.*

It should be the rule to employ machine-gun fire in a direction parallel to the probable front of the enemy; that is to say, in flanking positions.

The sweeping movement should be employed in firing frontally on a thin line, but its density then becomes insufficient and its effectiveness is small. (See fig. 280.) The machine gun is easily concealed; it should be kept out of sight and neglect targets of little importance; it should deliver bursts of fire which will come *as a surprise;* in this manner it may gain important results.

Any commander who has a machine gun and who uses it only to reinforce his firing line makes use of only part of the power at his disposal. He will use his machine gun to the best advantage in *flanking positions,* and he should select in advance several positions from which the machine gun can be used under various conditions, depending upon the probable course of the action.

Use of machine guns in trench warfare.—In trench warfare machine guns are ordinarily grouped in platoons, detached from the company and posted in strong positions. If the enemy is preparing for an attack he will make special efforts to destroy the machine guns. We should then fortify them strongly, screen them from view, and echelon them in the direction of depth. Machine-gun positions without overhead cover are to be invariably rejected, unless we have succeeded in concealing them from the commencement of the operation of entrenching.

Gun pits with strong overhead cover can not be used, on account of their relief, unless they are screened by favorable conditions, such as being on a second slope, by woods, underbrush, etc. We should instead prepare positions of low relief and well concealed, and nearby should dig deep shelters from which the men of the gun detachment can come quickly to the gun. The gun positions may be pits dug in the form of howitzer shell funnels, in front of the trench, and connected with the shelter by a tunnel.

We should increase the number of these positions and provide access to them by sheltered and concealed trenches, and should avoid firing frequently from positions which are to be

used in repulsing attacks. We should not expose all of our machine guns at one time to the danger of being destroyed by placing them all in the first line. We should echelon them beforehand and distribute the greater part of them between the line of supports and the line of reserves, in order that they may be able to crush an enemy who has penetrated the first-line trench at the conclusion of a bombardment or of an attack with asphyxiating gas.

Study in advance all sections of the foreground and mark their boundaries in order that every wave of an attacking enemy which appears in our front may receive machine-gun fire, and do not require machine guns to sweep long sections of the front. The *sector of fire* of each machine gun should be marked by three wooden stakes as explained in the instructions for digging trenches. (Fig. 47.)

In no case should a machine-gun detachment abandon its post; if need be it will permit itself to be besieged there and will defend itself to the last. The tenacity and heroism of a few machine-gun men has often enabled us to retake lost positions. To make it possible for them to do this, place the machine gun in a small earthwork, surrounded by well-hidden wire entanglements, and provided with several firing positions and furnished with food and water and an abundance of ammunition. For remarks on the subject of the ventilation of machine-gun shelters see paragraph 8, Chapter XIV, Book III.

Machine guns in maneuver warfare.—In maneuver warfare the machine-gun company often fights as a unit and is frequently placed near the head of the column behind the security detachments in order to support the infantry at the beginning of the action. When it has no special independent mission the machine-gun company should be placed at first under the orders of a battalion commander, who may assign one or more platoons of it to companies. In maneuver warfare machine guns are used in pits without head cover, as shown in figures 46–48.

The principal tactical rôles of machine guns.—On the offensive they deploy with the advance guard and cover the deployment of the main body; they reinforce lines temporarily halted; and gain time for a preparation for continuing the advance; they assist in the artillery preparation with rapid and concentrated fire, and take the place of artillery in a very rapid pur-

suit or in completing a victory; they advance on the flank of a body of troops in an attack, and cover their flank from the counter attack which will probably be made against it; and they cover with fire intervals which have been left intentionally or accidentally between two units of the attacking line.

On the defensive they provide along the front several successive barriers of flanking fire, which can be opened instantly by day or by night.

To sum up, we should (1) use machine-gun fire liberally to save the infantry, (2) always try to use it from flanking positions, (3) conceal the machine guns in order that their fire may come as a surprise, and (4) echelon them in depth and shelter them to prevent their being destroyed early in the action.

2. Automatic Rifles.

The characteristics of the automatic rifle are: (1) Great mobility; (2) destructive efficiency at short ranges; the fire is kept low automatically; (3) a certain efficiency at mid ranges; it is as accurate as the machine gun up to 700 or 800 yards, and has considerable dispersion beyond that range; (4) a great elasticity of action; its sweeping fire is easily handled and its fire can be shifted from one target to another instantly; (5) it can be fired while advancing, which keeps the enemy in his trenches during the last advances of the attack and allows our grenadiers to come up and do their work.

This weapon does not possess either the steadiness or the rapidity of fire of the machine gun and can not entirely replace it. However, its fire produces a similar moral effect. And it is at the disposal of small infantry units at times and under conditions where the use of machine guns would be impossible.

The automatic rifle is an excellent arm to accompany the infantry, to hold ground which has been gained, and to repulse counter attacks. This is due to the dense fire which it can instantly deliver and to its mobility. The automatic rifles make it possible, after studying and reconnoitering the position taken, to conduct the machine guns without loss of time directly to the positions most favorable for them, especially those from which they can obtain a flanking fire. In short, the auto-

matic rifle is the advance guard of the machine gun, which is chiefly a defensive weapon.

The combat efficiency of the automatic rifle requires a detachment of well-instructed and well-trained men, who should be of sturdy build on account of the weight of the ammunition. Its mechanism is sufficiently strong, provided the gunners are familiar with its action and know the cause of its jamming, and if they take care to protect it from mud and dampness, which are its chief enemies. On this account it should never be taken from its cover until it is to be used. A rectangular piece of oiled cloth should be fastened by its four corners over the lock and ejector; in firing two corners are unfastened and the cloth hangs by the other two.

The automatic rifle is less cumbersome than the rifle, although it is heavier. A sling should be improvised by means of which it can be carried while advancing or can be supported while firing during the advance; for accomplishing the latter purpose the sling passes over the left shoulder.

Rapidity of fire.—Firing single shots, a well-trained gunner can fire 60 to 80 well-aimed shots per minute. This is the most effective mode of firing, and it can be maintained for a considerable period. It is conducted in series of 20 shots, firing one shot at a time and keeping the weapon to the shoulder. A man can fire 1,000 shots in succession in this way without fatigue, aiming each shot. The eight automatic rifles of a company, firing single shots, have an intensity of fire equal to that of 60 to 80 ordinary rifles.

Automatic fire may be delivered in short rafales of two or three shots at a time or in longer rafales of seven or eight shots. A trained gunner can fire in this way 140 shots per minute, but this fire is not well directed and fouls the gun rapidly. The fire must be stopped after 300 to 400 rounds, or after two or three minutes, and the rifle must be taken apart and cleaned.

In firing while advancing several clips may be fired in succession; the clips may be changed without halting.

In the attack automatic riflemen and grenadiers form the leading element of the attacking line; they also compose the contact patrols sent forward after gaining the objective, with a view to exploiting to the utmost the success attained.

In occupying the captured position the automatic rifles form the skeleton of the new line. They can sweep the communicating trenches leading in the direction of the enemy and the probable routes of his reserves. It is well to employ a preventive fire at this time to shake the morale of the enemy and cause his counter attack to miscarry. The crater of a howitzer shell forms a sufficient shelter. Automatic rifles are placed, when practicable, in flanking positions; in occupying a broken line the grenadiers are placed in the salients and the automatic rifles in the reentrants, where they may flank the salients.

Organization.—It has been found necessary to group two automatic rifles together under the command of a noncommissioned officer. By using them in pairs a continuous fire upon a designated target can be maintained for the desired length of time; the two guns fire alternately. The squad of two guns is assigned a sector of the foreground to cover; the captain arranges the overlapping of the sectors in such a way as to cover the entire front.

Four to eight automatic rifles may be grouped together with either an offensive or a defensive mission; the important point is that they should be well commanded. Larger groups run the risk of becoming a target for the hostile artillery and being destroyed by it. The number of automatic rifles assigned to a company will soon be raised to 16.

Comparison of the powers of machine guns, automatic rifles, and ordinary rifles.

	Weight (pounds).	Shots per minute.
Machine gun	57	300
Machine gun with mount	120	300
Automatic rifle	20	140
Rifle with bayonet	11	11

Twenty-seven men will serve one platoon of 2 machine guns (equipped with 10,800 rounds of ammunition), or 9 automatic rifles (equipped with 9,200 rounds), or 27 rifles (equipped with 3,240 rounds).

3. GRENADES.

Characteristics.—The offensive and defensive powers of hand grenades have been described in Book III, Chapter IV. A trained grenadier can throw a grenade 35 to 45 yards with an error of 2 or 3 yards at the outside. His rapidity varies, depending upon whether he is using the metal fuse, which needs only a blow before it is thrown, or the automatic fuse, which has a protective covering to be removed. Under the most favorable conditions he can throw about 10 grenades per minute. The use of the O. F. (offensive fusante) grenade is becoming the rule in attacks over open ground. The F. 1 grenade is a trench grenade and is dangerous for men not protected by shelters of some kind within a radius of 165 yards. The O. F. grenade is frequently preferred to it, as it is quite effective and twice as many can be carried by the same number of men.

Rifle grenades can be fired to a distance of from 35 to 220 yards; but they can not be handled as rapidly as the hand grenades, and their tactical employment is therefore different.

ORGANIZATION.

(*a*) *Hand grenades and the grenadier's equipment.*—The first squad of each platoon includes 1 grenadier corporal and 7 grenadiers. It may fight as a unit (1 corporal, 2 throwers, 2 carriers, 2 assistant grenadiers, and 1 connecting file) or in two groups (1 leader, 1 thrower, 1 carrier, and 1 assistant). All members of the squad should be trained in throwing grenades. In each battalion one officer, detailed from one of the companies, has charge of the instruction and training of the grenade squads; he should be prepared, if necessary, to take command of all of the grenade squads of the battalion and handle them in action as a unit. The squads are assembled for instruction or combat at the order of the company or battalion commander; otherwise the grenadiers remain with their platoons.

The equipment of the grenadier includes the rifle and bayonet, the trench knife, and the automatic pistol. The throwers are not always required to carry their rifles when the attack is not to be followed up, for example, in a trench raid. With this

exception, the tendency of grenadiers to get rid of their rifles and to lay them aside during a combat must be firmly opposed. The grenadier should take a pride in his specialty, in the fact that he is an advance-guard soldier, and in the effective work which he can accomplish in cases where the rifle fails. But he should understand also that a grenadier who is out of grenades must not think that his work is done; he must fight with his rifle until more grenades come up. Attacks with limited objectives do not give an idea of what the supply of grenades will be during an advance of several miles or of several days' marches. It would be a mistake not to foresee that there will be a shortage in the supply for several days in succession and to separate the grenadier from his rifle at a time when the attack should be pushed to the utmost, with or without the grenades.

Grenade squads are furnished a number of baskets for carrying grenades or are equipped with belts for carrying them. A grenadier can carry, in addition to 6 boxes of cartridges, 10 F. 1 grenades or 20 O. F. grenades.

(*b*) *Rifle grenades.*—Grenadiers should be trained in the use of rifle grenades. V. B. (Viven Bessières) grenade tubes are issued to two men of every infantry squad. They are carried on the belt in a leather case. V. B. grenades are carried by these two men and by one carrier for each two firers. They have the advantage of being a very small encumbrance. The supply of grenades, relatively easy in the defense of a position, will be hard to keep up on the offensive, until the approach trenches have been constructed. The men equipped with the grenade tubes and their carriers must, on this account, be furnished at the outset with as many grenades as they can carry.

TACTICAL EMPLOYMENT OF HAND GRENADES.

Grenade fighting may have for its object: 1. The defense of a trench in close-range trench fighting. 2. Taking possession, step by step, of a trench or an approach occupied by the enemy. 3. Preparation for an assault on a hostile trench. 4. Close-range fighting within a hostile position and "mopping up" the trenches and bomb proofs. 5. A trench raid.

1. *In the defense of a trench.*—Some positions for grenadiers and for accumulations of grenades should be provided for in

advance in arranging the defensive sectors of the company and the battalion. Grenadiers are distributed in groups along the line; the number is increased on exposed fronts (in salients and parts which are very near the enemy's trenches). It is better, in the latter case, to double these portions of the trench by other lines very close to the first, so as to form substantially two ranks of grenadiers in these places.

All soldiers who have had any training in this work should be able to take part in forming a barrier with grenade fire at a distance of 30 yards; this can be done by one grenadier to 12 yards of front using O. F. grenades, and by one grenadier to 30 yards of front using F. 1 grenades. In order to avoid continual losses in places where the hostile trenches are very close to our own, a decided superiority should be seized in the throwing of grenades and the hostile trenches rendered untenable.

Some grenadiers' positions and grenade depots should be provided in the covering trench, at the entrance of the approaches, at the angles of long communicating trenches and in the cave shelters, in order to cover exit from them when the trench is invaded by the enemy, and also behind barricades. The different squads should be trained to make counter attacks with grenades quickly, to retake any part of the trench which may have been taken by the enemy.

2. *Step-by-step progress in a trench or communicating trench.*—In the dispositions taken in the communication trenches bunching up is always to be avoided. Only the minimum of men actually needed for the work should be exposed to the enemy's grenades, and they should not be so crowded as to prevent free movement. This form of fighting is very severe and frequent reliefs should be provided for; and the squad leader should be able to replace immediately an injured man, and to reinforce, if necessary, the leading group by fresh riflemen or throwers.

A profound silence should be maintained, so that all sounds coming from the direction of the enemy, and which might serve as an indication as to what he is doing, can be heard; communications should therefore be, as far as possible, by gestures and signals. Figure 159 shows the ordinary disposition of the men.

The throwers are constantly kept supplied by the carriers. They keep up their grenade throwing continuously; one throwing at the nearest group of the enemy, the other throwing as far as he can to the enemy's rear to block his supply of grenades.

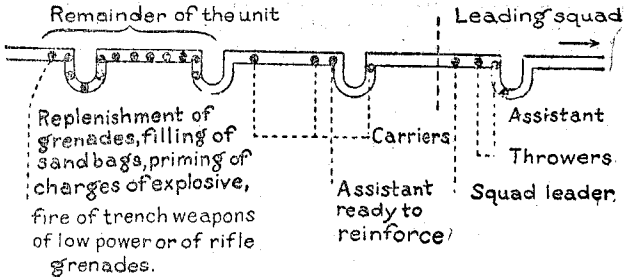

Remainder of the unit
Leading squad
Replenishment of grenades, filling of sandbags, priming of charges of explosive, fire of trench weapons of low power or of rifle grenades.
Carriers
Assistant ready to reinforce
Assistant
Throwers
Squad leader

FIG. 159.

Barriers of sandbags are torn to pieces as much as possible by explosive charges. When the leading group has reason to believe that the enemy has been overwhelmed (by a slackening or discontinuance of his grenade throwing or by significant sounds)

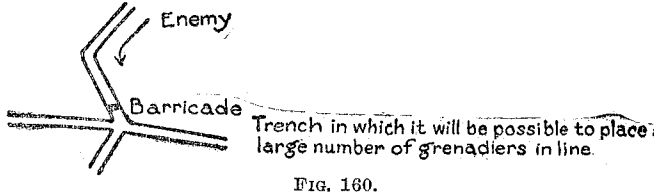


FIG. 160.

the grenade thrower's assistant should creep under cover of the smoke to a point from which he can see into the next angle of the trench and signal to his comrades; and progress is made in this manner from one angle of the trench to another or from one traverse to the next.

When the assistant perceives the entrance of a lateral trench he makes a signal to the throwers. Grenades are thrown into it, and it is then reconnoitered in order to avoid surprises. If ground is not to be gained in the new direction, a barrier of sandbags is constructed far enough from the main trench to be out of the range of grenades and a guard placed upon it. A squad is specially detailed to fill sandbags so that barriers can be put up without delay.

It is a good plan to make use of rifle grenades or trench mortars of low power to block the enemy's supply of grenades.

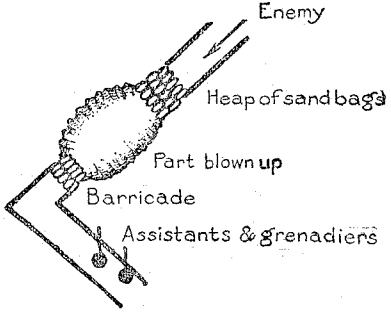


FIG. 161.

If the enemy gains a momentary superiority, his advance should be contested step by step until the superiority can be wrested from him. For this purpose the number of sandbag barriers should be multiplied to retard his progress, the trench should be obstructed by heaps of sandbags, or should be blown up so as to compel the enemy to show himself in the open before our rifles. (Fig. 161.)

The enemy may be drawn to a point where we are able to get into action a greater number of grenadiers than he possesses. The cries of wounded men may be simulated to draw the enemy under rifle fire and surprise him.

3. *Preparation for a grenade assault on a hostile trench.*—An assault is usually a combined action executed under cover of a powerful artillery fire. But sometimes a part of our line comes very close to the enemy and artillery preparation can not be made. An attempt is then made to overwhelm the enemy with grenades before rushing on him with the bayonet.

The throwers approach the enemy, taking advantage of all cover afforded by the ground; the remainder of the squad awaits under cover the moment for making the rush. The throwers overwhelm the enemy with a shower of well-directed grenades and compel him either to vacate the trench or to take cover in his bombproofs; the assault is then made.

4. *Close fighting in the enemy's position and "mopping up" trenches.*—An assault is followed by a struggle within the hostile position. Preparations may be made in advance for this struggle by a reconnaissance of the enemy's defensive organization. Certain groups of grenadiers can then be assigned to definite tasks; for instance, mopping up the trenches and bombproofs, or gaining ground through the communicating trenches toward the enemy's second or third line. The units which are assigned these tasks are required to rehearse them before making the attack.

Mopping up trenches requires two kinds of work which are quite distinct and which should not be assigned to the same units: (*a*) The crushing of hostile units which continue the resistances at certain parts of the trench, and (*b*) the mopping up proper; that is to say, searching the trenches and bombproofs with a view to making sure that none of the enemy are left in them.

The units which overcome the final resistance of the enemy are composed for the most part, if not exclusively, of grenadiers. They advance with the first or second wave; they are continually on the alert and seek out the points of resistance, skirting the trenches in order to approach them on their weakest side.

The units charged only with mopping up the trenches have a definite task; they skirt the trenches and approaches rapidly and arrange their work in such a way that no part of the hostile position shall be neglected. In order to lose no time the moppers up do not go down into the trenches and approaches; they shower grenades along their route and they give especial

attention to bombproofs whose openings may have been covered up by the artillery bombardment so completely as to hide them. Prisoners are collected and taken to the rear under the charge of the officers or noncommissioned officers of the moppers up or by units specially detailed for this task.

5. *Trench raids.*—Grenades are freely used in trench raids. Trench raids are executed (*a*) by small groups of selected men, who have confidence in one another and are specially trained in handling grenades, or (*b*) by a selected unit, sometimes reinforced by additional officers or noncommissioned officers, leaving the unreliable element behind.

The object of trench raids may be to throw grenades into an occupied portion of a hostile trench, to attack the head of a sap, to seize and hold an excavation, or to capture an outpost or small trench in order to obtain prisoners. The success of operations of this kind depends chiefly upon the preparations which have been made beforehand in the way of careful reconnaissances and by rehearsing in rear all phases of the operation under conditions as nearly like the real ones as possible.

Preparation for trench raids.—Meticulous care should be exercised in preparing for trench raids. The special preparations which an officer who is to conduct a trench raid should make are as follows:

(*a*) To make and have made all necessary reconnaissances (of the ground, of the obstacles, hostile trenches, etc.). The terrain should be studied with the object of selecting the routes of approach and of finding cover for grenade throwers within reach of the hostile position. The organization of the enemy's position may be studied from photographs taken by aviators.

(*b*) To select the best conditions for the operation (weather, hour, etc.).

(*c*) To assign to each group or squad of grenadiers a definite task.

(*d*) To arrange the best possible system for keeping up the supply of ammunition and grenades.

(*e*) To acquaint the infantry and artillery units which are to support the operation thoroughly with his plans for executing it.

The officer who commands the trench raid should personally direct the units performing the main task. One of his subordi-

nates should be specially detailed to supervise the replenishment of grenades.

Execution of trench raids.—The troops making the trench raid approach the hostile trench silently; if preparation has been made by artillery fire the approach should be rapid. When they reach the points selected for crossing the obstacles (which are supposed to have been destroyed) a volley of grenades is thrown into the hostile trench; as soon as they burst the grenadiers rush the trench.

Similar tasks are performed by two units, which, on reaching the hostile trench, proceed to mop it up, one going to the right and the other to the left. Every care should be taken to avoid being caught under a discharge of hostile grenades; a position a few yards in rear of the trench which has been attacked may have been prepared for this purpose by the enemy. Sometimes it is better to select a very dark night or very bad weather for the raid. An understanding should exist between the groups of grenadiers and the garrison of the trenches from which they start. A few rifle shots fired under conditions agreed on beforehand warn the raiders that an illuminating shell is to be fired. The raiders lie down and take advantage of the light by examining the ground in their front. As soon as the light dies out they make a rush and then halt, if necessary, for another illuminating shell. During the mopping up of the trench the throwers' assistants provide for security in accordance with instructions given them before the start.

Supply of grenades.—Keeping up the supply of grenades should be a constant source of care to all commanders. The most careful provisions should be made to prevent the grenadiers being short of ammunition, and these provisions should be established on the basis that for every two grenades sent up from the rear only one arrives at its destination. Instructions for ammunition supply are given in Book IV, Chapter IX.

4. Rifle Grenades.

Tactical use of rifle grenades.—Rifle grenades efficiently handled may demoralize the enemy and inflict upon him greater losses than are caused by the artillery bombardment. The hostile trenches should be minutely studied and the points at which

the enemy may be taken at a disadvantage should be reconnoitered (sentinels' posts, the entrances of bombproofs, crossings of approach trenches, etc.). The rifles, on their supports, should be directed continuously on these points, in order to be able to fire a grenade at the least indication of movement. The fire of rifle grenades upon selected localities will be kept up night and day.

In spite of the fact that the enemy is seldom seen, that his first line is thin, and that he is sheltered in bombproofs, it is possible to cause him considerable losses by keeping up a continuous hail of rifle grenades on well-chosen localities.

V. B. GRENADES.

The Viven Bessières rifle grenade is a part of the infantry equipment. All of the men should be trained in its use. The number of grenade tubes issued is limited by their weight and the limitations of ammunition supply. The V. B. grenade has the advantage that it is not very cumbersome and that it is fired by means of the ordinary ball cartridge.

Employment on the defensive.—Fire for effect on the defensive by the V. B. grenade is employed to inflict constant losses upon the enemy, to demoralize him, to hinder his trench work. The barrage defensive fire is used to repulse attacks. The 16 grenade tubes of a company can fire 150 grenades per minute, and can make, at a distance of from 90 to 165 yards, an impassable barrier. It is often a good plan to group the grenade firers of the company in groups of from 2 to 4, commanded by a noncommissioned officer.

Fire for effect is based on knowledge of the routine in the enemy's trenches. An especially well-organized observation service is indispensable. By a combination of observation, study of photographs taken by aviators, study of the map, and information from all sources, the targets and the hours for firing which will give the best results may be arrived at.

POSITIONS FOR RIFLE-GRENADE GROUPS.

Barrage fire is made by combining the use of rifle grenades and hand grenades for the purpose of repulsing hostile attacks.

This kind of fire is important when our communication with the rear has been broken or when the proximity of hostile trenches renders artillery barrage fire ineffective. *Example:* Figure 161a is a part of a plan, scale 1 : 5000. The captain traces upon it the hachured line K K as the line upon which he wishes to bring a barrage fire with the rifle grenades. This done, he notices that

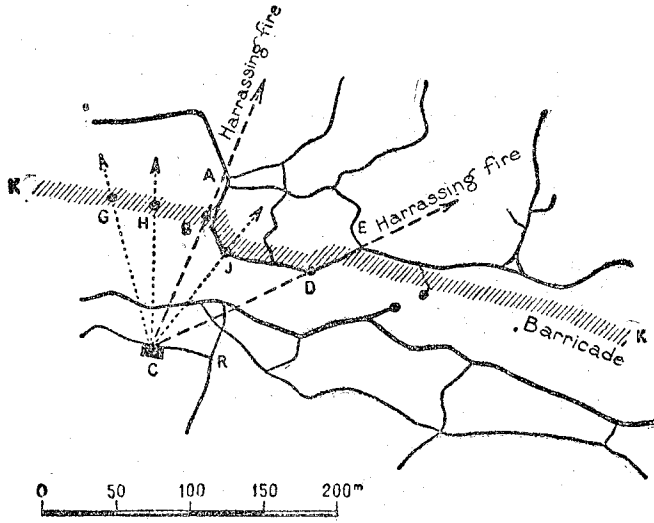


FIG. 161a.

a part of the hostile trench A B will be enfiladed by a group of rifle grenades posted in the covering trench at C. The plan shows that C is 45 yards from R, a thrown junction. He also observes that from C the part of the trench D E can be enfiladed. This will form a second target. Other groups of the company will be posted in view of similar considerations.

The part of the barrage which falls to four grenade firers posted at C, calculated with reference to the front of the company G J, gives 33 yards for each firer to cover. The captain then marks the points G, H, B, and J 6 millimeters (one-fourth inch) apart. He then measures with his scale the distances C G, C H, C B, C A, C J, C D, and C E and ascertains the azimuth angles of their directions. He makes in this way a sketch containing complete firing data for the rifle grenade group at C. It includes:

(*a*) For all of the grenade firers, for their first fire, a common azimuth C A; all ranges from 100 yards to 150 yards, in order to bring fire upon the whole line B A.

(*b*) For the second fire, a common azimuth C E; all ranges from 120 to 175 yards, in order to cover B A.

(*c*) For each firer, an individual barrage fire with a given range; for the firer on the left it would be azimuth C G and range 110 yards. For the others, azimuth C H and range 100 yards, azimuth C A and range 100 yards, azimuth C J and range 80 yards.

The rifles are placed on supports and laid with a compass and plumb in the desired direction and elevation. Each firer should understand clearly what he is to do at the command, "first fire," "second fire," or "barrage fire."

EMPLOYMENT ON THE OFFENSIVE.

The V. B. grenade is used on the offense to extend the radius of action of the hand grenades, in reaching an enemy under cover at a greater distance. In many local combats, where it is not practicable to obtain artillery support, it takes the place of this support by accurately bombarding the strong points of the hostile line. It isolates hostile groups attacked with hand grenades, cutting off their retreat, and preventing reinforcements from reaching them. It is very effective in repulsing hostile counter attacks. In any situation, but especially on the offensive, it is better to concentrate the fire of V. B. grenades.

D. R. GRENADE.

In comparison with the V. B. grenade, the D. R. grenade or shell has twice the range and much greater power; but it is a

more cumbrous projectile, and its supply requires more men for the same number of grenades. So it can not replace the V. B. grenade in offensive action, but it is useful in consolidating the occupation of a position.

In defense the D. R. grenade can supplement the artillery support; it is useful in harassing the enemy and for quick concentrations when an assembly is ordered.

In the attack it can strengthen a line which has been taken and can replace artillery in the preparation of an attack against a nucleus of resistance which has been isolated or left behind in the progress of an attack. It supplements or creates alone the destructive effects of field-artillery fire. It is well adapted to the preparation and support of trench raids, to the isolation and capture of small objectives, to covering the retirement of attacking troops when they have accomplished their mission, etc.

5. Low Power Weapons (Trench Mortars).

These weapon are described in Book III, Chapter XII. Their range is from 55 to 330 yards. They are effective especially against the personnel of the enemy on account of their curved fire, which the rifle can not achieve. Their chief use is in defense; however, the new weapons are light enough to accompany an offensive and can be brought into action quickly in a newly taken position.

Location.—The best effects are obtained from oblique fire and when the effects can be observed easily.

Positions are prepared for them both in the vicinity of the advanced trench and near the trenches of the supports, and the same pieces are ranged from one or the other of these positions according to the results which are desired.

Fighting in the communicating trenches.—Pneumatic mortars and D. R. grenades are advantageously employed in impeding at considerable distances the enemy's supply of grenades and in blocking his lines of retreat.

Additional positions are prepared for them further in the rear, so placed as to enable them to fire on our most important communicating trenches and upon portions of our first line which are most open to attack by the enemy. If the mortars

are placed in the rifle trenches they should be separated from the positions of the riflemen by traverses.

The utility of trench mortars consists:

In demolitions.—They are effective only in destroying small advanced works, such as listening posts and small earthworks

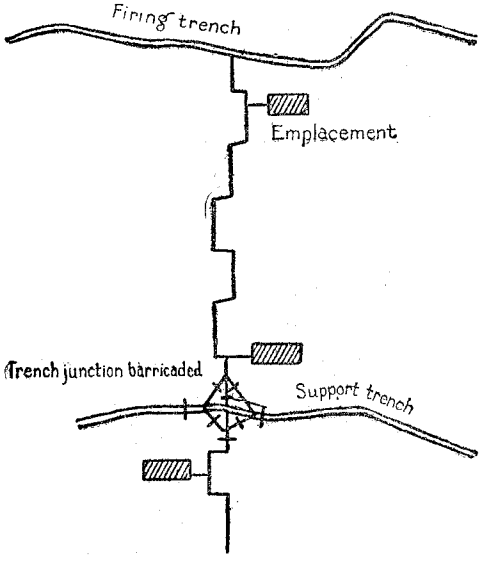


FIG. 162.

in process of construction. For this purpose the fire should be delivered rapidly. One hundred and fifty to 200 small shells can demolish a listening post and about 16 yards of the trench leading to it.

In offensive fire action.—They are used during the artillery fire preparation for the attack against portions of the hostile

line which appear to be neglected by our artillery and high-power mortars. After the attack has been launched they are used against parts of the enemy's line which our infantry can not reach and which must be prevented from taking in flank portions of our line which have advanced.

In defense.—When the enemy is evidently preparing to attack, the trench mortars which can not assist in repulsing the attack should not be left in exposed positions near the first line. They should be taken to the positions which have been prepared for them in rear, where they can bombard the trenches and approaches which the enemy may occupy.

In causing losses to the enemy.—During lulls in the fighting rapid fire should be opened unexpectedly in order to harass the enemy during the heat of the day, during a rainstorm, on dark or still nights, when the enemy is changing reliefs, at the hours for meals, etc. Fire for this purpose may be combined with that of rifle grenades, whose functions are very similar to those of trench mortars.

6. 37-Caliber (1.5-Inch) Guns.

The tactical characteristics of the 37 gun are: Its mobility and the lightness of its ammunition permit it to accompany infantry in all phases of the combat. It can be hidden easily, can be dug into the ground with little labor, and can be used for masked fire. It can be laid easily. It is very accurate. It can hit individual targets up to 1,300 yards, and has an effective range up to 1,600 yards. It is a rapid firer, and, for short periods, can be fired as fast as 20 rounds per minute. Its percussion-explosive shell is used against personnel and materiél, and its steel shell is used against screens and shields. Its effectiveness is similar to that of a grenade, but its shell can pierce, before bursting, two or three thicknesses of sandbags, a wooden barrier, or a steel shield. Its fire has very little effect upon earthworks. *It can, by direct fire, destroy hostile machine guns which show themselves.* Its fire is very effective against troops upon which it can bring an enfilading fire.

In offensive action.—The 37 guns are generally under the orders of the battalion commanders, but in some cases they are kept at the disposal of the regimental commander. They are

used for preparing and supporting attacks, for crushing hostile resistance during an assault, and for assisting in consolidating the occupation of a captured position.

For the purpose of preparing and supporting an attack the 37 gun must be placed, before the attack is started, in a position from which it can fire effectively to destroy the positions of machine guns which disclose themselves at the last moment, to fire upon positions which menace the flank of the attacking line, or to fire on the second or third lines of the enemy. In order to avoid having them destroyed prematurely by hostile artillery fire it is better to keep them out of the action till the last moment.

Use during the assault.—During the assault the 37 guns are brought forward as soon as they can no longer fire effectively from their first positions or when the infantry need their assistance in crushing a hostile resistance. This change of position should be provided for in the order for the attack. On account of their vulnerability the 37 guns should never accompany the first waves of the attack; they should follow the reserve of the battalion or of the regiment. They are used in destroying machine-gun positions and in sweeping hostile trenches and approaches which can be fired on from enfilading positions. They should not be used at very short ranges when it can be avoided. They should use masked fire as far as possible.

Occupation of the captured position.—In consolidating a captured position the employment of the 37 guns is similar to that of machine guns. They are placed so as to be able to fire on positions from which it is thought that the enemy will launch a counter attack; positions for oblique fire are looked for. It is always advisable to provide a number of masked positions to avoid being spotted by the hostile artillery.

In defense.—Attempts are constantly made to shell hostile firing positions and observation points reported by our information service. A number of positions should be prepared along the line assigned to the battalion and in rear of it. During the violent bombardment preceding a hostile attack the 37 guns should not be kept in the first line. By putting them in action near the line of supports, or a little in rear of that line, they can assist in making a barrage, especially by enfilading fire. They should fire on portions of our front where our artillery barrage is uncertain (on account of natural obstacles, dead angles, etc.).

Finally, the 37 gun is well adapted to masked fire; it can register on important approaches, trench crossings, etc. But the range should be checked at each shot, for, although it is a very accurate weapon, its range will change considerably during the course of one continuous firing if the atmospheric conditions change.

CHAPTER VI.

PRINCIPLES OF FIELD FORTIFICATION.

The purpose of the use of field fortification by troops engaged in battle is to lessen the deadly action of hostile fire and also to afford the means of holding a position strongly with weak forces. The second mission is fulfilled by arranging the trenches so as to take advantage of the machine guns, machine rifles, grenades, and trench weapons with which the infantry is now armed.

In battle the numbers engaged are so great, and the effects produced or suffered are so tremendous, that *continuous* lines of trenches occupied by *continuous* lines of combatants are necessary. These lines succeed each other or are constructed successively in the direction of depth in sufficient number to shelter the firing line, the supports, and the reserves during the most important halts in their general movement to the front. They are joined together by a system of communications, which must be *as complete as possible*. The continuous line includes *strong points*. But these must be concealed in a network of trenches, zigzags, and dummy trenches. Isolated strong points spotted by photography (hostile aeroplane) become traps under hostile bombardment. Moreover, breaks in the continuity of the line of trenches permit the enemy to drive wedges into our lines. The continuous trench also takes away from the defenders that feeling of isolation they would feel if in a work separated from the general line.

After the battle, on the contrary, upon a front being consolidated, the problem is one of very effectively occupying the terrain and doing it with a much smaller number of men than during active combat. This is the general case; it is no longer per-

missible to occupy constantly a continuous line. Finally, to this purely defensive organization must be added all of the necessary arrangements for making an offensive upon part of the front. *It results from this that the organization of a sector, therefore, in each particular case is a problem depending upon the military situation and upon the terrain* (Flanders, Champagne, the Vosges, etc.). It also depends upon the weather and the amount of labor and kind and amount of material available. The principles which follow are those which would govern in the defensive organization of a position under the conditions usually found.

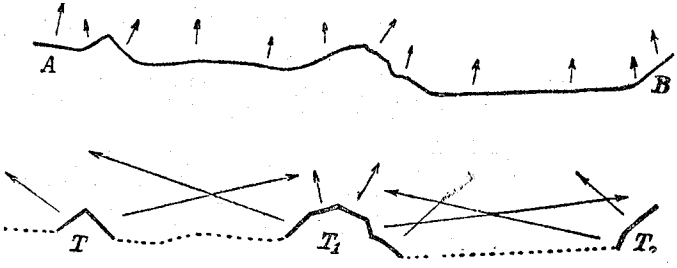


FIG. 163.

1. It is unnecessary to have a *continuous line of fire*, provided the terrain in front is completely swept by fire either *from the front* or *from the flank*, or, better still, *from both front and flank*. *The line with intervals* will generally be the rule. Figure 163 shows how a portion of the terrain may be entirely swept, either by a continuous line of fire AB or by a line with intervals composed of the elements T, T_1, T_2.

2. In a line with intervals it is, however, essential that the *obstacle be continuous* and, moreover, that the intervals appear to the enemy just like the parts that are adjacent (fortified), in order that the enemy may not be able to make out our plan of occupying the position. For this reason join up the trenches and strong points by means of dummy trenches and zigzags.

Everything must be arranged in such a manner that a photograph taken from an aeroplane shall be absolutely illegible to the enemy and shall reveal nothing as to our method of occupation and intentions.

3. The rapidity of fire of modern arms permits us to get along with narrow fields of fire.

4. *The location of good flanking defenses is the guiding factor and must dominate every fortification trace.* The flanking defense assures the convergence of powerful fire upon points attacked. It permits the employment of a line with intervals, with the resultant economy in men exposed to the dangers of the first line.

5. The true method of diminishing the vulnerability of a body of troops lies in *putting in the line only such numbers of men as are strictly indispensable.* The inherent strength of the position is found in the skill with which the *trace is laid out*, in the excellence of the *flanking defenses*, and in the *determination* of the little groups of defenders, which, while each has its work cut out for it, are still coordinated with the rest of the defense.

6. Men thus economized constitute strong reserves and work to *improve* and to *increase the communications* to the rear. The latter permit the rapid and certain arrival of *supplies* and *reinforcements.* They also permit the bringing up of troops for *the counter attack* and are consequently the *vital element* of a position and can not be too much developed.

7. It is necessary to *deceive* the enemy by all kinds of devices and to put the personnel in bombproof shelters in order to escape premature destruction.

8. Finally, it is necessary to organize the defense against surprise and to make provision so that the defenders, sheltered during the bombardment, arrive in ample time at their firing positions.

Active and passive sectors.—It is very rare that the trenches nearest to the enemy have been methodically laid out and fulfill the idea of a line with intervals, provided with flanking defenses. They are much more likely to be a continuous but pieced-together line, such as the events of the combat have made necessary. Nevertheless they must be occupied in accordance with the announced principles. It is the duty of the commanding officer

to divide these continuous trenches into *active sectors* and *passive sectors*, only the former being provided with a garrison and fulfilling the rôle of a distinct element (strong point) in a succession of such elements that go to make up a line with intervals, the latter being held only by the *fire of the flanking defenses* of the active sectors, which form the framework of the position, or by the frontal fire of active sectors of the

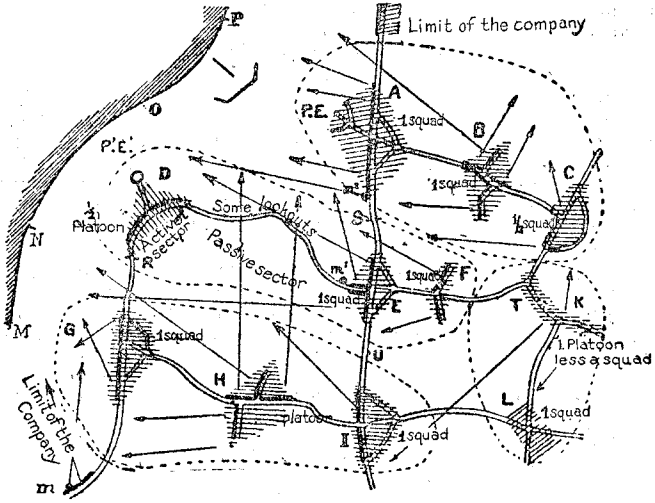


FIG. 164.

trench in rear. The passive sectors serve generally as *communications* between the active sectors. In case of attack they may, depending upon the *plan of defense*, be reservoirs for reinforcements, or serve as *outlets for counter attacks*, explained below. The active sectors may be considered as "isles of resistance," having a front of from 25 to 50 yards in length, and the passive sectors as lines of prolongation of from 45 to 110

yards. Figure 164 shows an example of the occupation of a position of this nature.

DEFINITIONS.

Element.—The simplest of the distinct "isles of resistance" may be called *elements* or *active sectors.* They are generally made up of a small collection of trenches and barricades, and receive as a garrison a *complete unit*, from a squad to a platoon, having special orders to fit their location.

Strong points.—The joining together of several of these elements, grouped together in depth as well as from right to left, forms a *strong point* or a *work*, the garrison of which is a company or a fraction of a company. This work may be constructed as a *redoubt.* In rear of the *strong points of the firing line* others are constructed, the purpose of which is to limit the success of the enemy.

Supporting point.—The grouping together of several strong points, both in length (side to side) and in depth, is called a *supporting point* and is limited in strength to a battalion or several companies, under the orders of one commander, who furnishes the garrisons for the *strong points* and also the *reserves* for executing a counter attack. The supporting point may be a redoubt, and sometimes artillery is assigned to it.

Sector.—Finally, the joining together of several supporting points under the same commander is called a *sector.* A sector is generally held by a division, and is divided into *subsectors* of brigades and regiments. The force assigned to defend a sector has its own separate reserve, distinct from the reserves of the supporting points. To reserve for the words *sector* and *subsector* the meanings which have just been given them, sometimes the ground occupied by a *battalion* is designated as a "*quarter*" and that occupied by a *company* as a "*subquarter.*"

Position.—The first position is therefore composed of a *line of supporting points* grouped according to the judgment of the commander into sectors. Every defensive system has as a minimum two positions, the second constructed at a certain distance (say, 6,500 to 8,750 yards) from the first, so that it can not, simultaneously with the first position, be brought under the fire of the heavy batteries of the enemy nor of his guns used

to throw asphyxiating shells. Between these two positions other intermediate positions—as many as may be considered necessary—are organized, depending upon the terrain and the means available.

The dividing up and assigning of the terrain.—One must not get the idea that a position is simply a line of supporting points, with narrow intervals, placed side by side, thus forming an uninterrupted line of defense. Just as the lines of successive trenches (first line, supports, reserves, intermediate trenches) divide up the ground in a frontal sense, the supporting points are often made up of groups of active elements, little works, isles of resistance, etc., which form zones perpendicular to the front, separated by other zones less well defended. The former zones, strongly defended, divide up the terrain. Their location is generally fixed by the inequalities of the ground and the existence of natural strong points (ridges, crests, woods, villages, etc.) Figure 165 is an example of dividing up the ground which gives the main features of one of the sectors of a position.

The zone of resistance which encircles the sector is intended to deny to the enemy access to the interior of the sector. It comprises the line of observation, the first line, and the line of supports. The line of redoubts and the defensive works, supported both by the line of supports and the line of resistance, are intended to inclose an enemy who has taken the offensive and penetrated to the interior of the zone. They overwhelm him with frontal and flank fire ,and at the same time our counter attacks are launched from both the reserve trenches and the intermediate defenses which still remain in our hands. Thus a breaking through by the enemy of our zone of resistance ought to have no other result than to lead to his annihilation. These explanations are necessary in order to understand the plan of defense and the mechanism of counter attacks. (Part VII.)

CHARACTERISTICS OF THE DIFFERENT TRACES.

The ideas which follow are based upon the standard types of works (coupure, redan, bastion, redoubt) the geometric forms of which, rarely perfected, facilitate the laying out and the

explanation. It is then easy to apply their principles to any trace whatever.

The straight line trace—Coupure—Advantages and disadvantages.—The simplest trench is the right-line trench, called "*the coupure*" (special case, the barricade). It is the one which can be most quickly made and the one which a line of

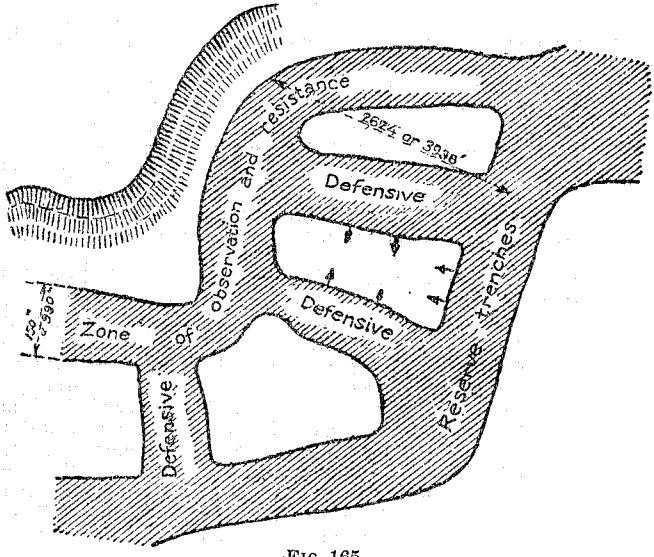


FIG. 165.

skirmishers (firing line) instinctively constructs when brought to a halt in the course of a battle. It is disadvantageous in that it gives a field of fire only to the front or an oblique fire which does not exceed an angle of 30°. Men fire perpendicular to the parapet instinctively. Attacked in flank, a coupure is enfiladed and becomes untenable.

The broken-line trace.—The disadvantages of the straight-line trench just mentioned make the broken-line trace preferable,

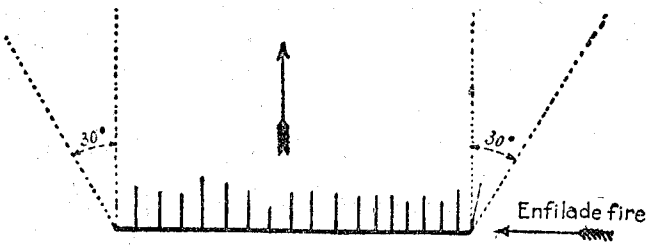


FIG. 166.—Limits of oblique fire.

and it is, moreover, better adapted to the terrain unless the country is absolutely flat. (Fig. 167.)

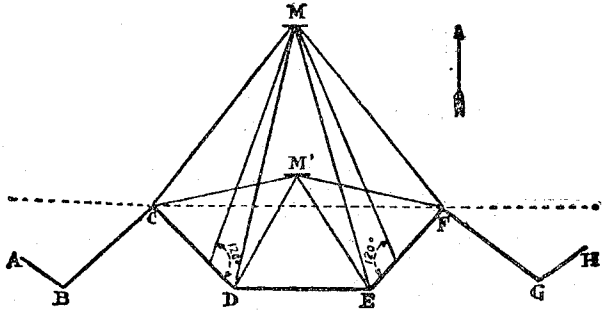


FIG. 167.—Broken-line trace.

Salients and reentrants.—The line of trenches thus constructed always presents in its development on the ground *salient angles* and *reentrant angles.* The former have their

vertices toward the enemy and the latter their vertices toward the defender. This succession of salients and reentrants gives

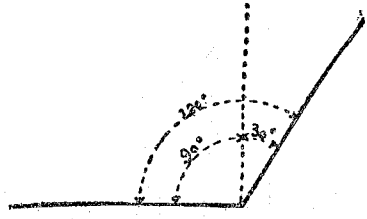
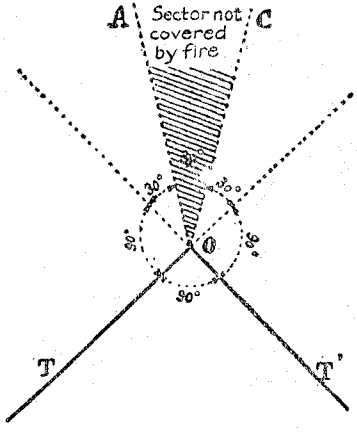
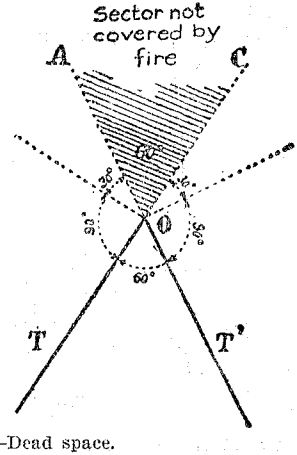


FIG. 168.—Limits of a reentrant angle.





FIGS. 169 and 170.—Dead space.

oblique positions, by means of which the defenders can bring a *crossfire* upon the terrain over which the enemy must pass.

Thus, an enemy M (fig. 167) seeking to penetrate the reentrant CDEF is swept in front by fire from the troops along the parapet DE and obliquely by those along the parapets CD and EF. The fire from the two last named becomes more and more effective the farther the enemy advances toward M; and there will come a moment when the sheaf of fire of a single machine gun, placed in the vicinity of C or F, will enfilade the entire hostile line from end to end, thus *perfectly flanking* the part of the parapet DE. and the direct fire from DE will no longer be necessary to stop the enemy.

From that which precedes we must conclude: (1) *That the reentrants constitute the strong parts of a broken line* since they have, across their front, a cross-fire which becomes more and more deadly as the attack advances. [Figs. 169 and 170 show that the sector upon which no fire can be directed diminishes as the angle at the salient is opened.] (2) That men can be economized on the line DE in case all or part of CD and EF can deliver an effective fire. The minimum limit of a reentrant angle is naturally 90°, since the defenders of one branch or face of the angle, if it were less than 90°, might fire on those of the other face. (Fig. 167.) If it is desired that the terrain in front of the two faces be entirely swept by fire, then the reentrant ought not to be more than 120°. (Fig. 168.) (3) On the contrary a salient forms a weak part of the line—the assailants can overwhelm it with converging fire, and if it is isolated it can answer only with a divergent fire, and in some cases not at all. * * *

Dead spaces.—If the salient of an angle O (figs. 169 and 170) is less than 120° the trench T can fire as far as the line OA, and the trench T, as far as the line OC, leaving the angle AOC in which *direct* fire can not be delivered Such angles are called *sectors deprived of fire* and constitute what are known as a *dead space.* Figure 171 (flanking arrangements) shows how to remedy this grave defect by *arranging a flanking fire.* AB and DE flank the salient O. Figure 172 shows that there is no dead space when the salient is 120° or over. Figure 173 shows that, although the trace in a broken line admits of covering better the immediate foreground, still this arrangement results in dead spaces, or at least in ground not thoroughly swept farther to

the front. This disadvantage is obviated by the use of rapid fire arms.

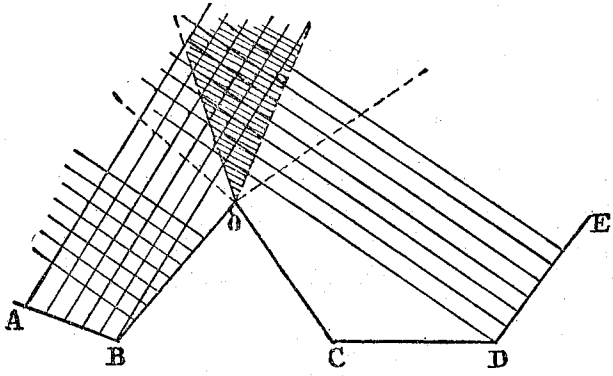


FIG. 171.—Flanking fire.

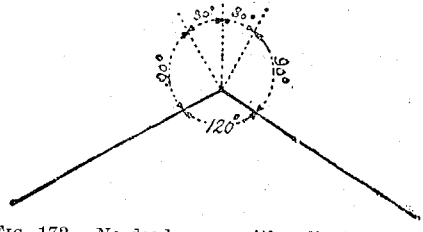


FIG. 172.—No dead space with salient of 120°.

The different types of traces of broken lines are as follows:

1. *Traces with indentations.*—The parts parallel to the principal line of *fire* BC and DE and the *flanks* AB and CD, etc., follow each other in the same order. This trace gives good protection from flanking fire. (See fig. 174.)

2. *Tenaille trace.*—The line of fire is broken in such a manner that the two contiguous parts BC and CD, mutually flank each other. (Fig. 175.)

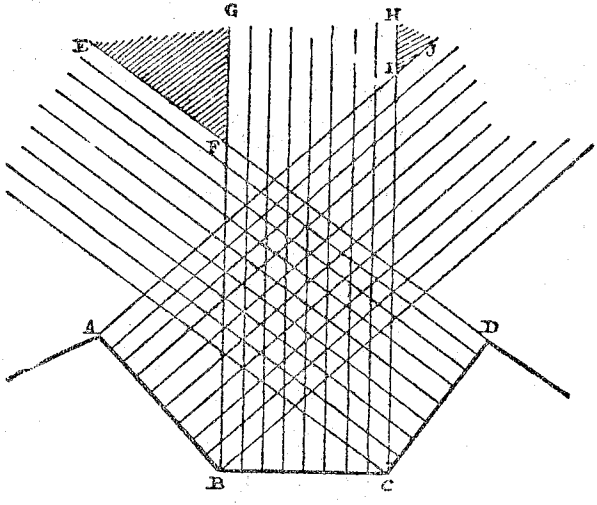


FIG. 173.—Advantages and disadvantages of the broken-line trace.

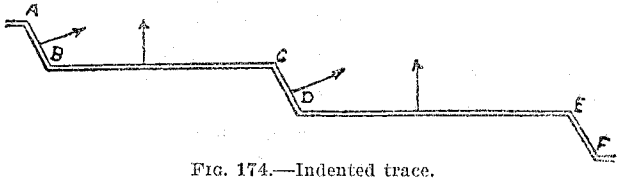


FIG. 174.—Indented trace.

3. *Trace with redans.*—*A redan* is simply a salient considered as a separate work. The sides of the angle are called the faces. If it has not been possible to make the angle greater than 120°,

a blunted salient of several yards in length is arranged to fire on the dead angle. A machine gun should be located in the blunted salient. Figure 176 shows a simple redan, and figure 177

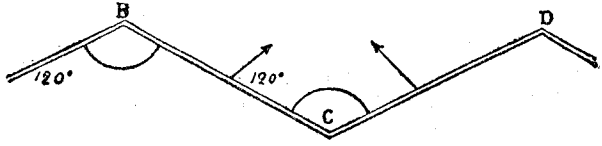


FIG. 175.—Tenaille trace.

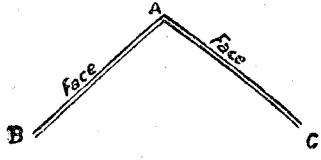


FIG. 176.—Redan.

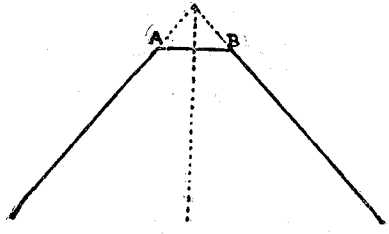


FIG. 177.—Blunted salient.

shows one with a blunted salient. In the double redan, the flank fire is arranged by indentations in the faces of the redan. (See fig. 178.) The *redan trace* is a broken line, consisting of redans united by *curtains*. (See fig. 179.)

4. *The trace with bastions.*—If to the faces of a redan two refused flanks are added, the result is a *lunette*, which, if it forms part of a polygonal trace, is called a *bastion*. [Fig.

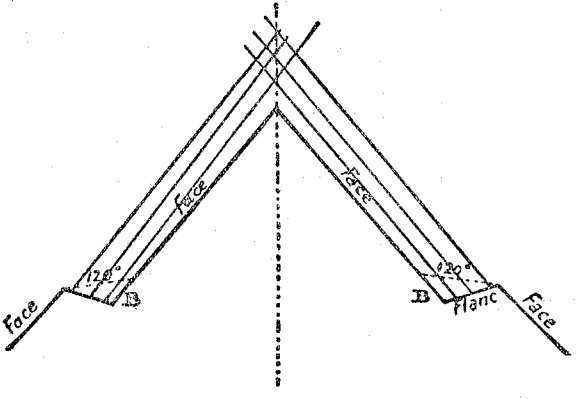


FIG. 178.—Double or flanked redan.

180 shows an ordinary lunette and also a flattened lunette or a half redoubt.] In a *bastioned trace* (fig. 181) the *flanks* of each bastion enable the defenders to deliver a cross-fire before the *curtain* and also a fire flanking the *faces* of the adjacent bastion.

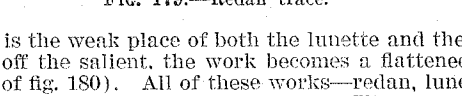


FIG. 179.—Redan trace.

The salient is the weak place of both the lunette and the bastion. By cutting off the salient, the work becomes a flattened lunette (right half of fig. 180). All of these works—redan, lunette, half redoubt—are said to be *open at the gorge*. They are very difficult to defend if once their flanks are turned.

Redoubt.—The *redoubt* is a closed work, capable of offering an obstinate resistance even when completely surrounded. It also

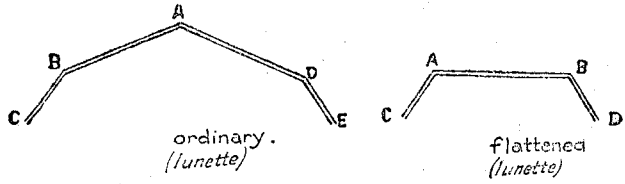


FIG. 180.

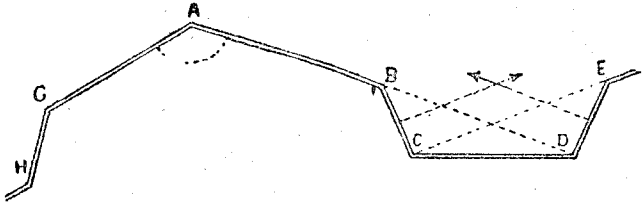


FIG. 181.—Bastion trace.

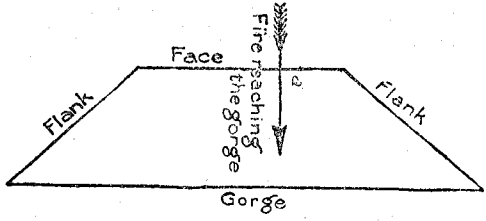


FIG. 182.

favors an offensive return on the part of the garrison. It must be protected as much as possible by traverses and parados, the

defenders thus being able to receive fire without fear from every direction. [Fig. 182 shows a redoubt of four sides, and fig. 183 one of five sides. Fig. 184 shows a redoubt with traverse and parados.]

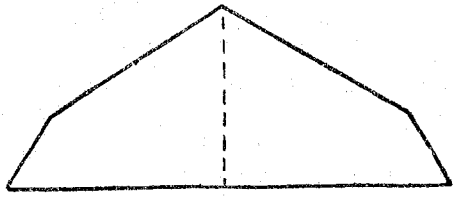


FIG. 183.

Application of the traces previously described.—The trenches and the works, however they may be made, are never actually regular or exact in construction. For that reason it may be said that they are merely theoretical and serve to teach the

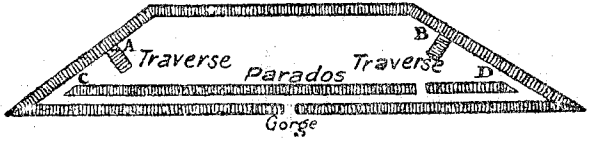


FIG. 184.

names and attributes of those works. *Every trace must, above all, be laid out to fit the terrain,* and as there are very few straight lines in the ordinary ground forms, the firing crest must be curved as much as is necessary. For this reason there will result a series of salients, reentrants, bastions, or irregular redans and curtains, more or less sinuous, having, with relation to each other, the properties already described above.

ELEMENTS OF A POSITION.

All positions, first, second, or intermediate, comprise in the beginning the same elements and are defended in the same manner. They are, as has already been stated, *lines of the supporting points*. The defense of a supporting point is organized in depth by making: (*a*) A first line of resistance (firing trenches); (*b*) a line of supports (support trenches); (*c*) a line of reserves (reserve trenches).

Organization of the firing trenches—The firing trenches are on the line upon which the advanced fractions of the defending force receive the first shock. It is formed by a series of works, strongly occupied (active sectors), bound together by a continuous trench. The front of the whole is covered with

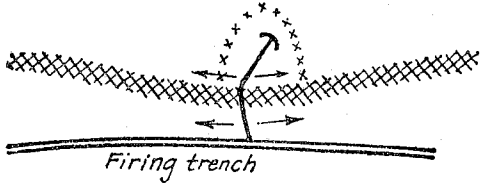


FIG. 185.

an uninterrupted network of barbed wire, of as great a density as possible. It is always bound together in rear by a series of zigzags, at least one for each platoon (approach trenches, fig. 186).

It is not a disadvantage even if the firing line is only 100 yards from the enemy, since, in that case, he will no longer be able to use artillery fire against our firing trench through fear of hitting his own firing trenches. But the firing trench must be out of range of hand grenades or hand-propelled liquid-fire grenades (45 yards). If too close, there is likewise the danger of its being mined.

Small posts.—In front of the firing trenches are thrown out *small posts* or even *watch trenches*, likewise surrounded by barbed wire. (Fig. 185.) These dispositions, even though occupied by comparatively weak forces, offer a first resistance

to the enemy, and thus allow the flanking defenses, which sweep the zones of accessory defenses, to come into action. The trench giving access to a small post will, moreover, usually serve as a flanking defense for the adjacent parts of the first line (fig. 185). In the absence of small posts, the sentinels and men on the watch station themselves in the firing trench, which is in that case sometimes designated as the "watch trench." This is, however, a misnomer.

Small posts should not be abused; that is, do not construct any more of them than are needed. Their garrisons, though small, are immobilized and can not, therefore, be used for any other purpose. Do not push these posts in advance of the firing trenches unless there are good reasons for doing so, such as getting observation or arranging flanking defenses that could not be obtained from the main trench.

Cover trench.—The first-line trench is sometimes doubled by constructing a second trench about 45 yards in rear of it, which permits an immediate counter attack, or, in case of a very violent bombardment and lack of bombproofs, allows the garrison to take refuge in the immediate vicinity. The second fire trench, built at leisure, relieves the defense of much anxiety.

Profile of the firing trench.—The normal type of firing trench has been given in Chapter VIII, Part II, sappers school. (Fig. 35.) Narrow, deep trenches afford the most protection from the fire of artillery, grenade guns, grenades, and bombs; but the circulation of reliefs, etc., and the transportation of wounded, in such trenches, is very difficult, and the troops are forced either to widen them and deepen them at the bottom, so as to allow moving about, below the banquette tread of the firers, or else to dig a special communicating trench, from 12 to 15 yards in the rear. The depth of the cover for troops moving about in rear of the firing trench should be at least 1.8 meters (6 feet) and is frequently as much as 2 meters, or better yet, 2.5 meters (8 feet). In places particularly exposed to enfilade fire, niche traverses may be installed. (Fig. 187.) This likewise affords a method of constructing a firing trench from an old trench, the exterior slopes of which have crumbled away here and there.

Keeping in good condition.—A constant struggle must be maintained against the inroads of the weather, by the use of

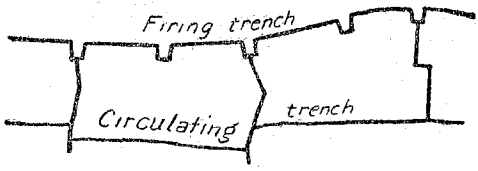


FIG. 186.

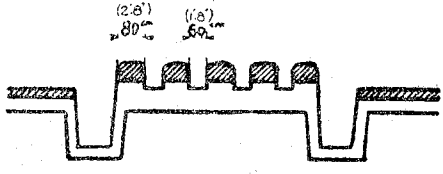


FIG. 187.

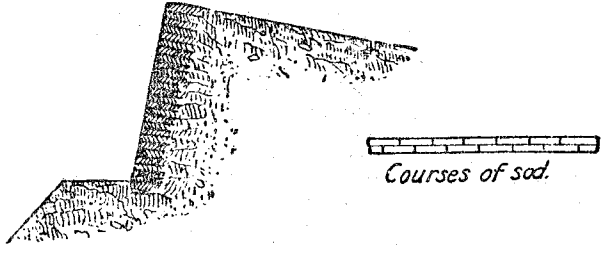


FIG. 188.—Sod revetment.

revetments of turf, sandbags, planks, wickerwork, metallic trellis work, etc. The most important parts to maintain in their

original form are the exterior slope and the firing banquet. It is absolutely forbidden, in principle, to dig under the ex-

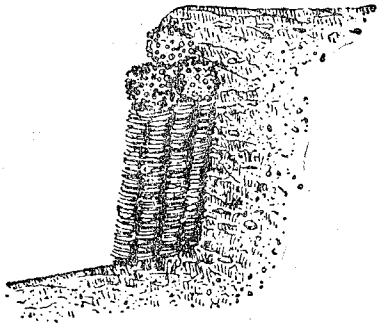


FIG. 189.—Gabion revetment.

terior slope of the parapet, in any way which might weaken the same and cause caving in.

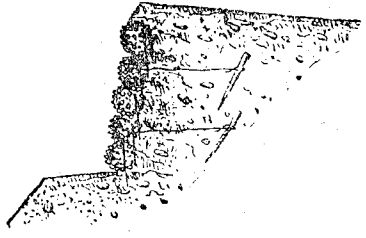


FIG. 190.—Fascine revetment.

Dugouts or niches for ammunition, entrance to shelters, etc., under the parapet, must be firmly shored up by means of timber.

[Figure 188 shows a sod revetment and how a double row of sods is laid so as to give increased strength by breaking joints.] [Figures 189 and 190 show, respectively, revetments of gabions and fascines.]
Fig. 189 and 190 here.

Drainage.—When the terrain has an even general slope, it is possible to drain the trenches by a series of carefully made drains. It is necessary to make certain that the water is carried away to lower ground or to natural excavations, and not toward other firing or communicating trenches. If the soil is permeable or is composed of a thin stratum of clay underlain by a per-

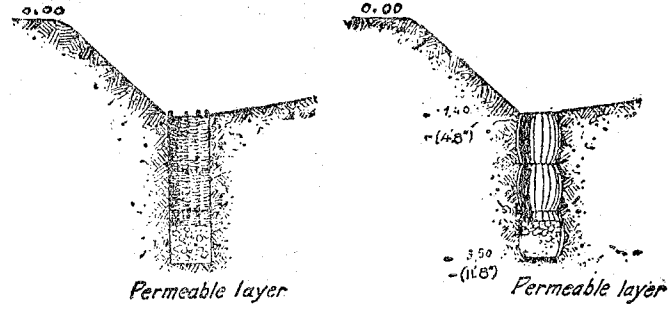


FIG. 191.—Cesspools.

meable one, conveniently spaced cesspools are dug to carry off the excess water. The bottoms of these pools are covered with small stones in order to prevent them from becoming clogged with trash and drift. Figure 191 shows two types of cesspools. In an impervious soil, cesspools will not answer the purpose. A regular system must be organized for getting rid of the water, such as by means of pumps, dipping up with pails, and hauling away, etc. The only certain way of making the bottoms of the trenches fit to occupy in argillaceous soil is to place poles or timbers there and to have on top of these a grating of planks or split poles. Beneath the gratings dig cesspools and drains con-

necting them so that the water and mud will drain into the pools. (See fig. 192.)

The best revetments are those made of sandbags very full and very well beaten down. Any other kind bulge out and narrow the passageways by thus spreading out, after a time. When that occurs, they must be moved farther out or the trench turned aside. An abnormal enlargement or a round point interrupting the cover certainly diminishes the amount of protection; but

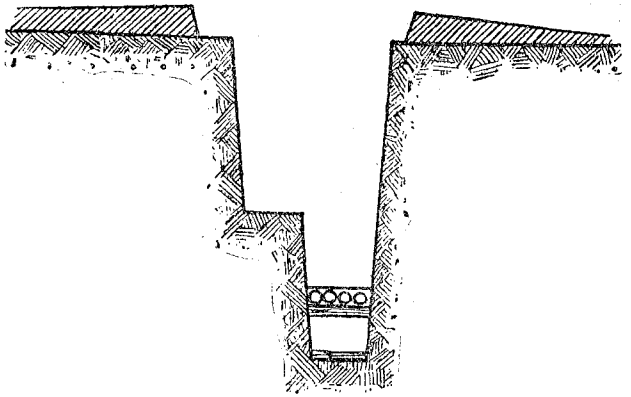


FIG. 192.

anything is preferable to an obstruction of half of the passageway due to the yielding of the revetment to the pressure of the earth.

Loopholes.—The employment of loopholes is not advisable unless it is possible to build them so that the enemy will not know whether they are occupied or not. This condition makes it necessary to do without loopholes on a greater part of the firing crest close to the hostile trenches. The loophole is used, however, in lookout posts and in trenches for flanking the enemy

either defiladed or at a distance. The exterior opening must be concealed by some such device as a piece of closely woven-wire screening stretched over the outside opening of the loophole, which allows one to see through and also does not impede the passage of the rifle barrel when the soldier wishes to fire. It is important that the opening shall not have behind it the sky or other background which contrasts with the color of the

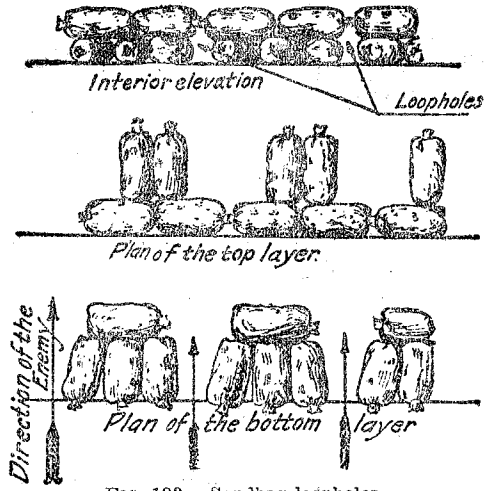


FIG. 193.—Sandbag loopholes.

ground. With this in view, loopholes are established which do not jut out from the parapet; or the parados may be raised above the parapet; or a cloth may be stretched behind the head of the firer, as shown in figure 195. When loopholes are made, their proper orientation is one of the principal cares of the platoon leader in the trenches. It is necessary to verify the direction of their fire, one at a time, in order to be certain that the

part of the trench where they are located may fulfill the tactical rôle which has been assigned to it. Every rifle, when resting

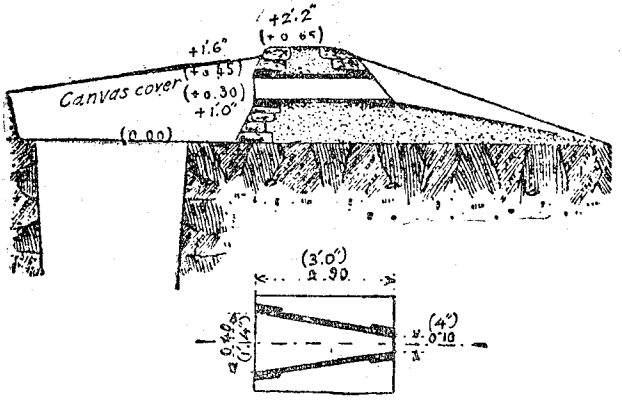


FIG. 195.—Wooden loopholes.

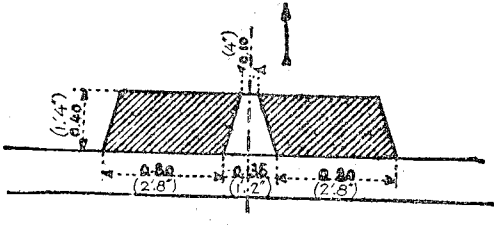


FIG. 197.—Gabion loophole.

naturally on the bottom of the loophole, should be pointed in the desired direction and its fire shall graze the ground, even at night when it is impossible to aim.

The necessity for this is evident. Care must also be taken that the loophole is not accidentally tipped up and that the rifle does not fire into the sky. All loopholes possess the inconvenience that at the moment that the assailant arrives within the zone of effective fire the defender must withdraw his gun in order to fix the bayonet, or if the bayonet has been fixed beforehand the movement to withdraw the gun preparatory to meeting the assault will be fraught with difficulty. Moreover, hostile bombardment destroys many loopholes. The loophole must be considered only an expedient of trench warfare, and ample arrangements must be made, by raising the banquette tread between the loopholes, so that the assault can be stopped by fire *delivered over the top of the parapet, in barbette,* which is the only method that allows the soldier free use of his rifle. Whenever it is possible (which is generally the case in flank defense)

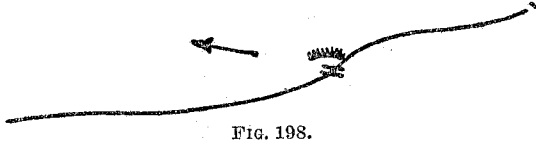


FIG. 198.

orient the loophole obliquely with respect to the hostile trench opposite, so that it will be invisible to the enemy, and the man firing from it can have complete protection for his head (fig. 198). When the trench is planned to deliver a fire not exactly perpendicular to its front it is well to prepare open loopholes, simply cuts in the parapet, which guide the fire of the men and remind them that they are not to fire mechanically to their front. When, in village fighting, a wall is loopholed, it is best to make the loopholes from 12 to 16 inches above the ground and to fire lying down. The low loopholes are less visible and more difficult to destroy than those at the height of a man standing. The loopholes should be spaced about 45 inches apart.

Traverses.—The normal dimensions of the traverses and the manner in which they are spaced have been pointed out in the sapper's school (Part II). The breadth indicated, 7½ feet, is a minimum, which should be unhesitatingly increased to 9 to

12 feet at places exposed to direct artillery fire. In the case of broad traverses it is well to arrange along the sides a firing banquette or row of loopholes, to insure the interior flanking

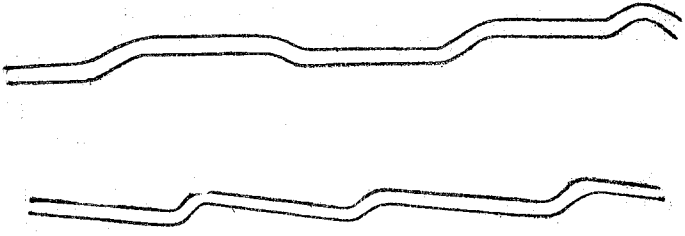


FIG. 199.

of the trench. Precaution must be taken at the same time to keep on hand material to close the trench at the tail of the traverse, such as sandbags, chevaux-de-frise, herissons, etc.,

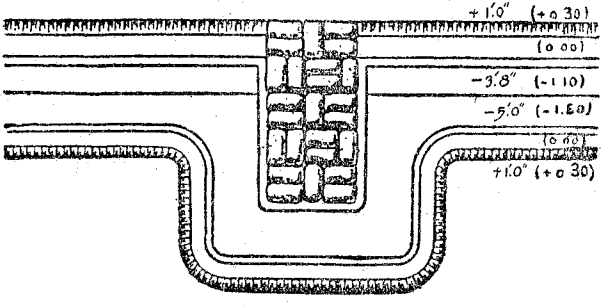


FIG. 201.

which are held on the berm near at hand for use when the emergency arises, thus admitting of the rapid transformation of the trench into a barricade. If there is not time to bring out

all of these fine points in the defense of a trench at the time it is dug, at least we can make jogs in the trench (fig. 199), which will provisionally assure the division of the trench into compartments, just as the traverses do. Later on splinter proofs and traverses of gabions or sandbags are constructed (figs. 200 and 201).

Protection against grenades.—This protection may be secured either by placing a vertical netting above the firing crest or by covering the trench with a roof of two skirts of grill work or poles joined together, the whole covered with a light thickness of earth.

The arrangement described in Appendix 4, Instructions for Grenade Combat (pivoting cage with metal trellis work), is very efficacious and has the additional advantage that it can be instantly utilized in case of necessity, as an accessory of defense to obstruct a zigzag or communicating trench.

Field of fire.—It is necessary that each element have in front of it a well-cleared field of fire, but in trench warfare we may content ourselves with a field of fire of *about 110 yards*, and even less, if the flanks are well secured and the *accessory defenses* are very well arranged.

Influence of ground in relief—Occupation of a crest.—Although the location of the crest of fire depends more often upon the circumstances of the combat than upon the choice of the defender who constructs it, still it is expedient to indicate how it is best to locate it, as regards the natural relief of the terrain, when one is free to do so, which is often the case with the second and third positions, if not with the first. In ground of even slope, the view being practically the same, wherever the location, this factor has but little influence on the choice of the site of the line of fire. On the other hand, in broken country, when it is a question of occupying a crest, there may well be doubt.

Referring to figure 204, it will be seen that the firing trench might be put at A, almost down at the foot of the slope, because the infantry could get a grazing fire over the terrain in front, which could also be easily swept by our own artillery fire, with good observations at B. But the terrain in rear of the firing trench is exposed to hostile view and can be swept by hostile artillery fire. Movements in this area will be difficult and counter attacks organized there will meet with many obstacles

in attempting to advance. The line which joins the most elevated points of the terrain is called the *topographical crest. The military crest* is the line usually in advance of the topographical crest, to which it is necessary to advance in order to bring into view all parts of the slopes below. In moving from the topographical crest to the military crest there is a dead space called the *dead angle* ABE. From the military crest toward the front, there is none. If the firing trench is placed at B, on the military crest, we will have a good field of fire and particularly good observation. But we will be exposed to the enemy's view and consequently to his accurate artillery fire. Moreover, the support of friendly artillery is often defective on a descending slope, such as BA. However, movements in rear of the line, and arrangements for counter attacks, are simpler in this case than in the one where the firing trench is

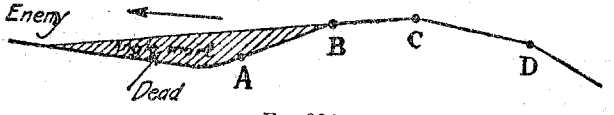


FIG. 204.

located at A. On the *topographical crest* C, distant views can still be obtained, but there would be in front of the firing trench considerable *dead space* which would be favorable to the enemy. The field of fire would also be poor.

Characteristics of the reverse slope.—On the *reverse slope*, at D, one no longer has a field of view, and the dead space will be still greater. But the trench and its wire entanglement can not be seen by the enemy, and is therefore sheltered from hostile artillery observation, without which the enemy's fire is liable to be ineffective. As far as assaults by the hostile infantry are concerned, it has been well established that hostile infantry is powerless to advance against a trench not swept by its own artillery fire, as long as the wire entanglements are intact and there is even a limited field of fire in front of the trench which is being attacked.

These advantages have caused the reverse slope to receive unusual consideration as a place to locate the first-line trenches. However, care must be taken not to employ it as a general solution that will fit every case. In fact, the recent progress of aerial reconnaissance and the methods of zone firing have taken away from the reverse slope part of its former immunity. Moreover, it must not be forgotten that the possession of observing points is of paramount importance, as much in trench warfare as in open campaign. Now, when one gives up the crest he deprives himself of observation. One must know, therefore, the advantages of the reverse slope and know how to profit by them, as, for example, in duplicating the crest trench by constructing a second trench on the reverse slope.

The *line of supports* and *the line of reserves* will generally be established on the *reverse slope.* Precautions will be taken, however, not to put them in low ground where gas might accumulate.

In every case the installation of the firing trench on the reverse slope implies always that there shall be lookouts in advance of the crest. These may be fixed in position or may consist of very active mobile patrols.

Flanking defenses.—Above all, good flanking arrangements must be installed for the whole front.

Flanking defenses.—Above all is it necessary that the whole front should be provided with good flanking defenses.

A firing trench is defended less by frontal fire than by its flanking defenses.—The value of flanking arrangements is so great that it is frequently recommended that *the flanking dispositions of a position be first constructed*, the other defenses being made afterwards. By breaks in the trace, by the creation of salients and reentrants adapted to the ground forms of the terrain, mutual flanking arrangements can be made between the different elements of each strong point, between the strong points themselves, and between the supporting points. It is absolutely necessary to establish these mutually supporting flanking defenses as soon as the general location of the firing line has been determined. These coordinated flanking defenses must sweep *each element* of the front, longitudinally, and, as far as possible, *the exterior border of the accessory defenses.* They must be organized in such a way that their fire will not,

by any chance, be directed upon any part or parts of their own defenses, and, also, so that they will be protected from the direct fire of the enemy. The traces which possess the most effective

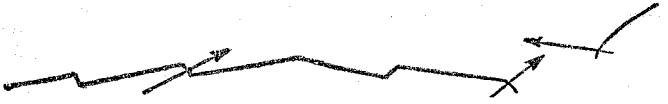


FIG. 205.

flank defenses are those with indentations and those with bastions. They will be adopted for those parts of the line which can be organized at leisure, which is generally the line of supports, line of redoubts of the first position, intermediate posi-

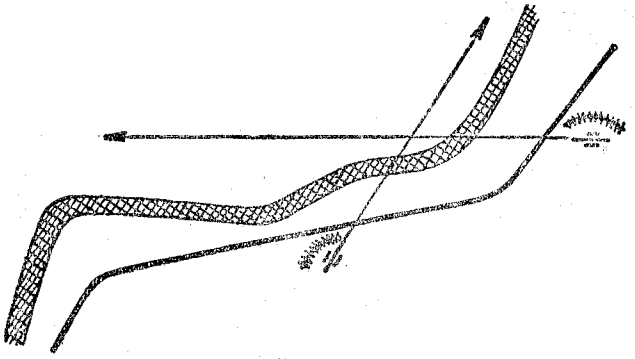


FIG. 206.

tion, and second position. In the advanced line, on the contrary, which is generally established through the exigencies of the combat, and not by the orders of the superior commander, the flanking defense is obtained after contact, by *arrangements*

which are often originated by company and platoon commanders. A short standing trench, with a parados, may be pushed to the

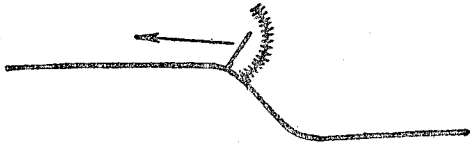


FIG. 207.

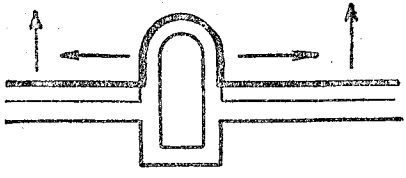


FIG. 208.

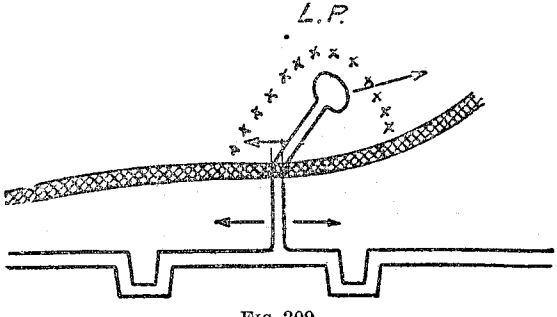


FIG. 209.

front. A few rifles or a machine gun may be placed in it. Care must be taken that it is not exposed to enfilade fire. Or,

a traverse may be used by constructing a circular trench element, making a salient to the front. Figure 209 shows how

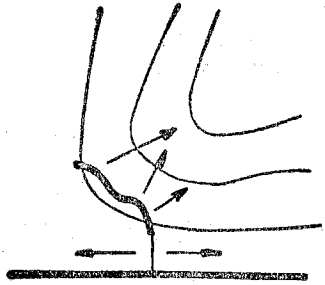


FIG. 210.

a communicating trench leading to a listening post may be utilized. If it has been found necessary to push to the front a

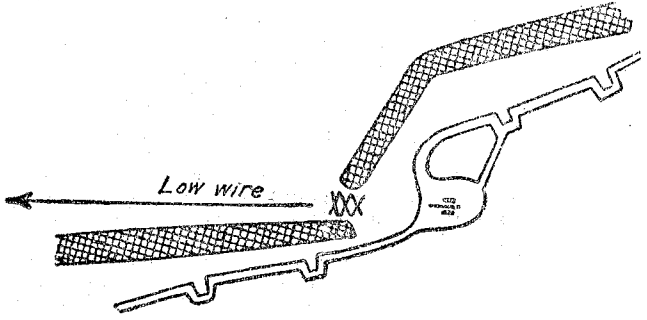


FIG. 211.

small work to sweep a dead space or a depression, take advantage in the same way of the communicating trench which

leads to it to get flanking protection for the main trench. (Fig. 210.)

The machine gun is the arm par excellence for use in flanking defenses.—It must be sheltered as much as possible and the emplacement or shelter must be completely covered, so that at the moment of attack the emplacement will be intact. Numerous emplacements should be prepared, well concealed, and with the guns in position; or the emplacements may be lightly armored, and not armed till the moment of need, the machine guns being held near at hand under the protection of

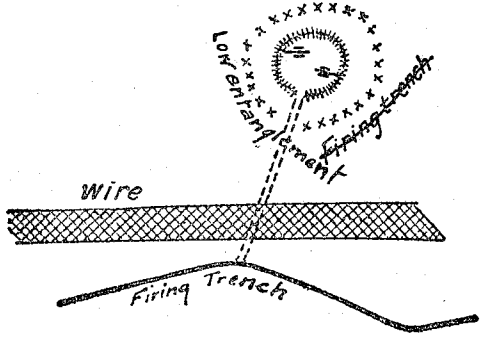


FIG. 212.

bombproofs. The digging of pits in the open ground well to the front of the trace of the firing trench, with which they are connected by subterranean galleries, as is shown in figure 212, also gives good results. For the distribution of machine guns between the first line, the support trench, and the line of redoubts, see Chapter V of this part (IV). The flanking arrangements from one supporting point to the neighboring supporting points by the use of machine guns, 37-mm. guns or 75-mm. guns, is regulated by the superior commander.

Arrangements for entering and leaving the trenches.—The steps (fig. 213) allow access to the natural surface of the

ground. They may be constructed at the rear of the trench or in the communicating trenches or in a parallel of departure from which an assault is to be launched. In the latter case it is well to replace the steps by scaling ladders, which have the advantage that they can be constructed without widening the trench. One type is shown in figure 214. Another type is made by using a picket 8 to 10 centimeters (3 to 4 inches) in

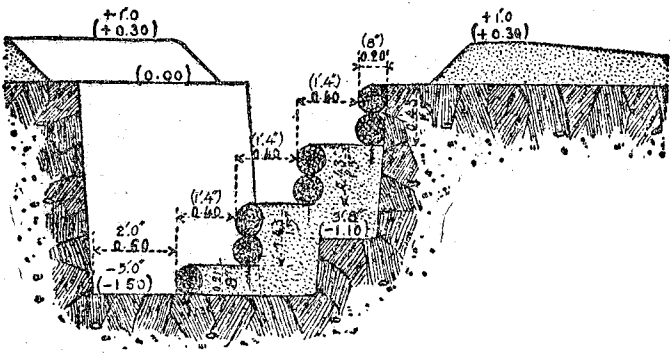


FIG. 213.—Sortie steps.

diameter, sunk vertically into the ground and flush with the interior slope, located preferably in the reentrant angle of a traverse, in such a manner as to project to a height of 20 inches above the banquette tread. The soldier steps on the end of this picket and climbs over the parapet. The steps may be replaced by ramps, which leave the communicating trench where it enters the firing trench. They are constructed parallel to the latter. Such a method is applicable when there is no material available with which to revet the steps.

Accessory defenses.—To the accessory defenses described in the sapper's school, such as wire entanglements and chevaux-de-frise, we may add the following:

The low entanglement formed of pickets 2 to 2½ inches in diameter, not more than 2 feet above ground, and wired in all

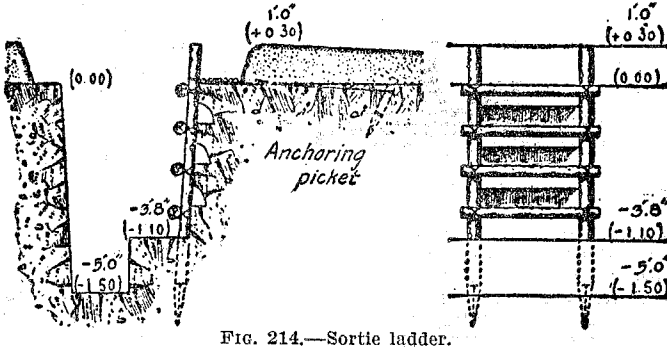


FIG. 214.—Sortie ladder.

directions. The vegetation renders this entanglement invisible even at a very short distance. *Loops of wire of small diameter*

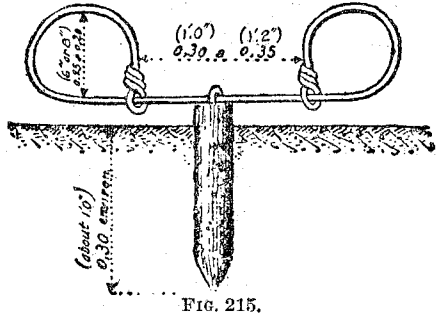


FIG. 215.

(figs. 215, 216, and 217) of different types are used. The simplest is made by a clove hitch or boatman's knot, the loops

of which are fastened together, it being so fastened to the ground that it remains vertical (fig. 216). *Crow's-feet*, of from 4 to 6

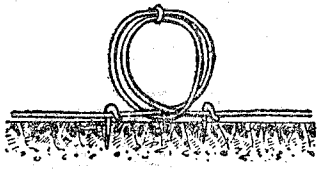


FIG. 216.

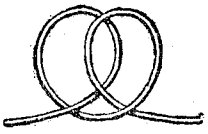


FIG. 217.

points, *wire stretched between the trees of a wood* and *single wire stretched along the ground* and anchored at intervals by pegs driven in the ground are also used.

Sharpened stakes, hardened in the fire, driven obliquely into the ground by striking on a small shoulder cut in the stake for that purpose (fig. 218). Trous de loup (fig. 219).

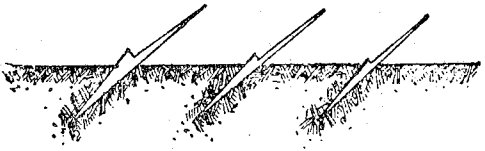


FIG. 218.

Figure 219 shows *trous de loup.*

Abatis of trees or of branches and entanglements of brushwood (figs. 220 and 221).

Accessory defenses should tend to fulfill the following conditions:

1. Concealed as far as possible from sight of the enemy on the ground and from aeroplanes above; placed, if possible, behind a natural or artificial inequality of the ground which protects them at the same time from artillery fire.

2. They must be placed from 35 to 55 yards in advance of the trench, so that a fire intended to demolish the trench will not

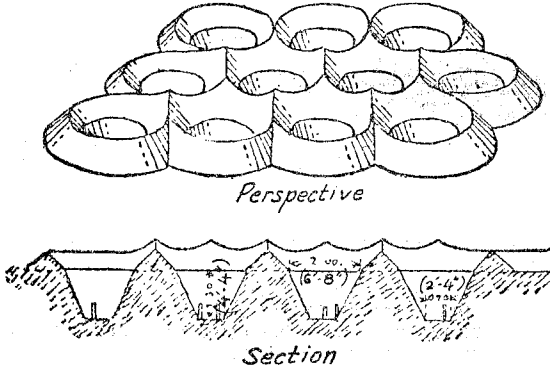


FIG. 219.

FIG. 220.

reach them. This distance is likewise necessary in order to keep the men operating the liquid-fire engines at a safe distance.

FIG. 221.

3. They must be perfectly and completely swept by the fire of the firing trench; *an accessory defense not so arranged is useless*, because the enemy can come and destroy it without danger to himself.

4. The trace of these works must be absolutely independent of that of the firing trench in order to baffle all attempts of the enemy to adjust his fire. The necessary salients must be made so that the fire of the flanking defenses can sweep the *exterior edges of the* obstacles (see fig. 222).

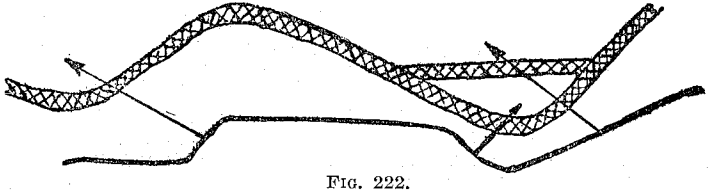


FIG. 222.

5. They must be arranged in *several strips*, separated by from 5 to 10 yards, rather than in a single strip or band. For example, make two wire entanglements each from 10 to 15 yards in width in preference to making one from 20 to 30 yards wide. *Begin by constructing in its entirety the band or strip that is to be farthest away.* The thickness should be greater in front of the passive parts of the line than in front of the active parts.

6. Arrange for *passageways* to the front for the use of patrols, sentinels, etc. They must be concealed or at least not easily discoverable and there must be material close at hand suitable for quickly obstructing them in case of the necessity arising for doing so. (Fig. 223.)

7. They must be *watched* carefully at night by listening posts dug at points along the edge of the obstacles or in front of them and themselves protected by accessory defenses. These posts have passageways leading across the wire entanglement and they give the alarm by signals, little bells, by firing, etc.

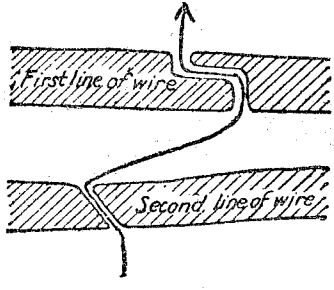


FIG. 223.

Before beginning an offensive the accessory defenses should be removed in order to give passage to the waves of assault. Crow's-feet, loops, etc., scattered irregularly about the ground possess the difficulty of being hard to find and of restricting the freedom of assault.

Dummy trenches.—It is always advisable to make dummy trenches; that is to say, supplementary trenches which it is not intended to occupy, with a view to deceive the enemy's observers whether on land or in the air, and to lead them into error as to the real occupation of a position and the distribution of the troops. It is often advisable, even, to establish them for the purpose of leading the enemy into a trap when he attemps to get a footing in them. With this object in view they may be

constructed in straight line elements, completely enfiladed (flanked) by the true trenches. If the enemy enters them he will be decimated at close range by the fire of rifles or machine guns, the locations of which are conveniently concealed. Figure 224 illustrates one method to be employed on the first line.

Take two trenches which have a lateral interval between them of about 65 yards and construct a dummy redan trench, the two faces of which are beaten by machine guns from the main trenches, as shown in the figure. Construct a false outlet to the front at the salient, by degrees, this serving as a sort of trap into

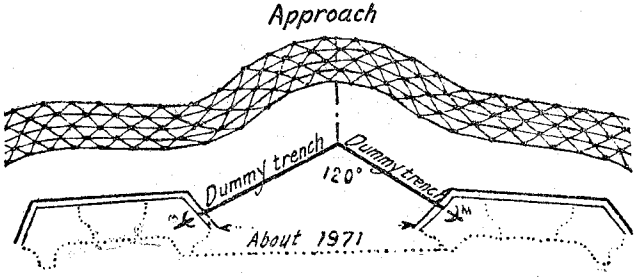


FIG. 224.

which the enemy may advance. The injury to these false trenches wrought by the hostile artillery must be repaired in order to prolong the illusion of the enemy.

TERRESTRIAL OBSERVATION.

COMPANY OBSERVERS.

1. *In the trenches, in a position in readiness, observation must be continuous, the same as when in combat.*

Each company must therefore construct a limited number of *observing posts*, which must be concealed (camouflé) and must not form a salient, and from which the fields of view overlap upon those parts of the hostile line which it is important to

watch, and which have been assigned to the company. These observers try to see everything that happens and to notice even the slightest indications of any movement. It is not absolutely essential that they should be located in the first-line trench or

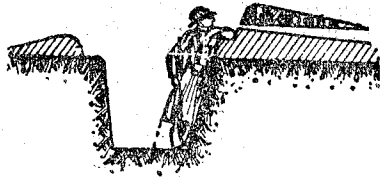


FIG. 225.

in the listening posts. Places will often be found behind these locations which will afford excellent views and be less likely to attract the attention of the enemy. The salients of the works, at which points one has more extensive views, are also favorable locations for these observing stations.

FIG. 226.

2. In addition to this continuous normal observation, it is also necessary to arrange for *lookouts during a hostile attack.*

The only guaranty of the defense is found, then, in a system of watchfulness capable of functioning, however severe may be the hostile bombardment.

As a rule there should be a lookout (watcher) installed near each shelter, who takes his post as soon as the violence of the bombardment makes it necessary for the men to go under shelter, and gives warning of an approaching attack. These watching posts must be armored and protected by every possible means, and have communication with the shelter of a kind that will surely work, in order that there may be no failure of the alarm

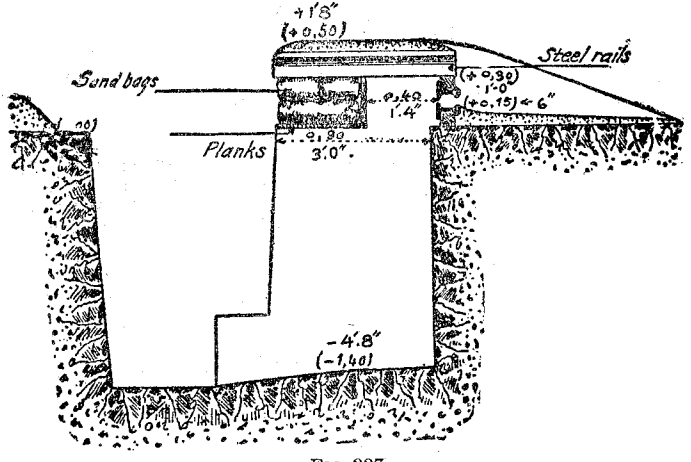


FIG. 227.

signal to perform its function. The watcher must give warning that the hostile artillery is lengthening its fuses and that the enemy is about to assault the trenches.

The officers and the noncommissioned officers who have come, under the menace of attack, to occupy the shelter with the other men must be able to watch the lookout at the entrance of the shelter in order to have him replaced by another if he should be put hors de combat. The entire defense rests upon this ar-

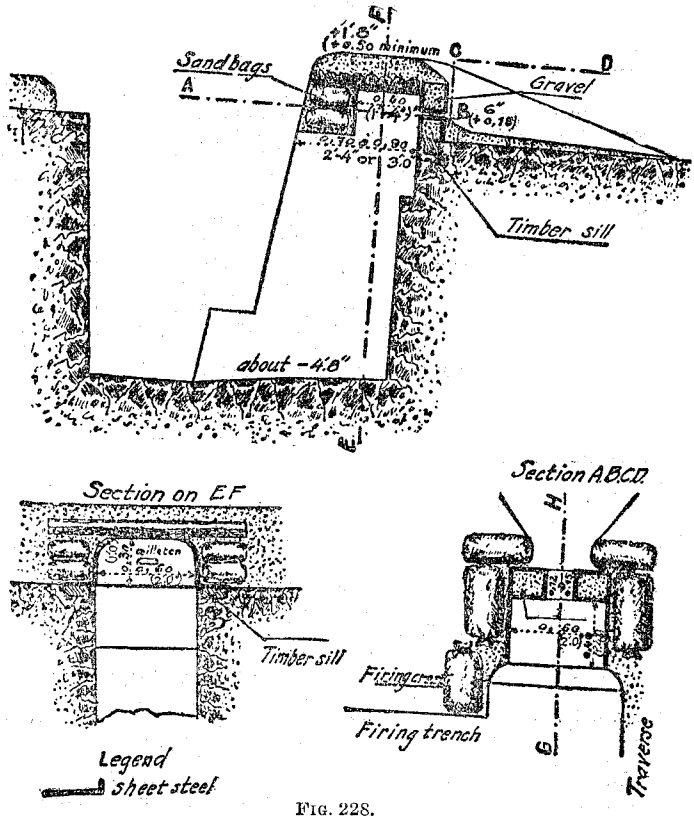

E
F
1'8"
(+0.50 minimum
Sandbags
C
D
A
Gravel
B
6"
(+0.15)
2'4" or 3'0
Timber sill
about -4'8"
Section on E F
Section A.B.C.D.
Timber sill
Firing
Firing trench
Legend
Sheet steel

FIG. 228.

rangement, failing which the men, surprised in their bomb-proofs, can not avail themselves of their means of resistance.

The same lookout posts may also be adapted to both of the missions just described. For this it will be sufficient to dig the shelters alongside the positions recognized as favorable for continuous observation, instead of making the shelters first and selecting the observation stations afterwards.

Installation of the lookouts (watchers).—If the time and the necessary material means are lacking, or it is feared that covered posts will betray the position, lookouts will be established without protection, their heads being concealed behind shrubs or tufts of herbage. In the daytime observation is kept up through loopholes of different forms (figs. 193 to 198), or by the aid of periscopes (figs. 138 and 139). To watch certain points it will often suffice to make a circular hole in the parapet with a sharp-pointed round stick or metallic tube. To permit observation with field glasses the loophole must have a breadth of 4 inches. To prevent alternating light and shade due to movements behind the loophole, it is advisable, in a post without a roof, to *stretch a cloth behind and above the lookout man.*

At night the watcher must observe *over the top of the parapet.* If the command is sufficient, the loophole is placed on the natural surface of the ground and the banquette is cut away in line with the loophole, as far as the bottom of the trench. The watcher will thus be well covered. At night he mounts upon the part of the banquette which has not been notched (see figs. 225 and 226). Armored lookout stations consist of niches or metallic boxes (figs. 153 and 154), or are as shown in figures 227 and 228.

ORGANIZATION OF TERRESTRIAL OBSERVATION IN A SECTOR.

In general the observation is organized methodically throughout the sector of a division in such a way as to complete and control the aerial observation, which, however much it may be perfected (by means of photography, etc.), is never anything but intermittent.

The scheme for observation, which is an indispensable part of the *plan of defense,* shows the *command posts* and the *artillery observing stations.* These latter are again divided into *information observing stations* with extensive view and *observing stations of more restricted view for adjustment* and control of fire.

The scheme for observation should include:

1. The map or chart showing the complete system of observing stations and the view obtainable from each.

2. A panorama sketch of the view from each.

3. The scheme of the telephonic liaisons (connections) between the observing stations and the command posts.

4. How the service functions (temporary and permanent observing stations, personnel of each, special orders for certain ones, what assistance the command posts and observing stations may expect to receive from the artillery observing stations, transmission of information, etc.). An observing station must be conveniently fitted up, protected, camoufléd (concealed), including the entrances.

There should be as part of the scheme of observation:

1. Special instructions (personnel, tour of service, sector to be watched, message service, particular points to be specially watched, what precautions to take with reference to *visitors of every rank.*

2. An observing station notebook in which must be written *at once* the observations made.

3. Sketches kept up to date of the hostile entrenchments and troops occupying them on a scale of 1–5,000, and, if expedient, on a scale of 1–10,000 or 1–20,000.

4. A map of the parts of hostile position seen and a panorama of same.

5. The necessary implements for keeping up observation, communication, etc.

The observers are trained until they can read with skill the maps and the panorama sketches and understand how to explore by sight the terrain thoroughly and methodically and to express their observations verbally and in writing completely and precisely. They *signal at once* any preparations of the enemy for attack and *note* every sign of activity or any change of appearance in the hostile lines. They send each day, at the hour or hours fixed, an extract from their notebook. In each body of troops the *information officer* discusses and coordinates all of these reports. He presents them to his chief and corrects to date the 1–5,000 sketch of the command post. Information of

interest and value is transmitted to the generals and from them to the second bureau of the army corps.

B. ORGANIZATION OF THE SUPPORT TRENCHES.

The support trenches are constructed from 165 to 225 yards behind the trenches of the first line and must be so located as to *bring the latter under their own fire* whenever it is possible to do so. This distance is great enough to insure that the same demolition fire will not destroy both trench echelons at one time, and also that in cases of surprise of the first line the garrison of the second line will have time to make the combat dispositions called for in the plan of defense.

The organization of the support trenches must be in all essentials similar to that of the first line, since they are intended to be a substitute for the latter in case it should be carried by the enemy. This rule is general and applies to all of the successive echelons of trenches behind the firing trenches, cover, support, line of strongholds, etc. Any trench may become at any moment, through force of circumstances, a trench of the firing line and must be constructed *in advance* to play such a rôle.

Moreover, the principal communicating trenches connecting the lines must likewise be organized for defense and have barbed wire stretched along the edges. If a momentary retirement is forced upon us, wire entanglements, loopholes, flanking defense, machine-gun posts, lookout posts, shelters, etc., can not be improvised in the course of the combat, and any failure to provide these things beforehand can not be remedied then. On the contrary, if these successive lines are provided with everything necessary a real partitioning of the terrain occurs, forming, so to speak, a series of solid walls of defense opposed to any attempt at a hostile advance, and providing at the same time points of departure for flank and frontal counter attacks. It would indeed be unforgiveable if the support trenches were not made much stronger than the firing trench, since there is much more favorable opportunity to trace, fortify, and surround the former with wire entanglements than the latter. In the same way, from the point of view of its tactical rôle, the support trench must be better than a mere second cover trench located from 100 to 170 yards from the firing trench, which latter can

rarely be methodically constructed and is hard to repair. The support trench, on the contrary, must aim to fulfill a very clear idea of defense and to that end must take advantage of all features of the ground, whether it is necessary to approach quite close to the first line or to withdraw to some distance from it.

It is therefore the real defense trench which has been selected and organized at will under the protection offered by the firing trench. Under these conditions it should be *inviolable*. Like the firing trench, it is not occupied uniformly, and has passive parts as well as active parts. The latter are logically placed behind the passive parts of the first line.

C. ORGANIZATION OF A REDOUBT.

When the center of resistance is completed by a redoubt, the latter should be a closed work, entirely encircled with barbed-wire entanglements. The distance from the line of support to the redoubt is very variable. It is intended to put up a resistance to the death, even if completely surrounded. For that reason it must have fields of fire in all directions, bombproofs, first-aid posts, water depots, with provisions and ammunition for a fight of several days. Its garrison will consist of one or more platoons in charge of an energetic commander. Each one of its faces has regular firing trenches, but there must be numerous traverses and parados for protection against enfilade and reverse fire.

Occupation of a point of support.—The normal garrison of a point of support is one company. For example, the captain might put three platoons on the line, each one disposed in depth into a firing line and a support line, the guards of one or two of the active elements of each line being actually in position. The reserve platoon is held together in the line of support or in the redoubt (fig. 268). The first line receives therefore from one-fourth to one-third of the strength, which is the normal proportion in outposts. The details of this service will be found in Part VII, "Infantry in the trenches." The tactical properties, assignment, and manner of locating the machine (automatic) rifles and machine guns, proper, will be found pointed out in Chapter V, Part IV.

Communications.—The communication trenches constitute artificial routes which insure at all times the replenishment of the firing line in men, ammunition, and rations, and the evacuation of the wounded. In the zone which extends from the places of arms to the advanced line they are numerous, so as to facilitate the movements of assaulting troops, reserves, and reinforcements. In rear of this zone they are not so numerous.

They are never too numerous, provided that their network is simple and clear, and can be used by a body of troops which has had time only to make but a summary reconnaissance of them. It can not be too much insisted upon that the approach trenches should be so constructed as to facilitate movement at night with as much freedom as in the daytime; that there shall be nothing to retard movement or to get hooked onto the clothing; that every inequality be leveled down and every hole filled up. This is the secret that permits a small number of effectives to hold a considerable front, which can be done without fear if it is known that reinforcements can rush up, at a rapid pace, to threatened points. On the contrary, if there is doubt as to how soon these can come up, then one is unwilling to risk the thinning out of the first line and useless fatigue work falls on the companies.

In the interior of the position the communicating trenches are, moreover, eventual *nuclei of defense*, and must be organized accordingly.

"Communicating trenches" is the special name given to those trenches which form passageways leading toward the enemy, and those parallel to the front are called *transversals* or *parallels*.

Profile.—The normal communicating trench has a depth of 2 meters (6½ feet) and is 3 feet wide at the top. (Fig. 43.) These dimensions are suitable for the principal *communicating trenches*. They may be reduced to 5⅔ by 2½ feet for the secondary ones. When it is desired to lessen the visibility the deep sap is adopted. (Fig. 44.) If it is desired to render them wholly invisible, they are covered with screens or hurdles, with a little earth placed on them. The width of the principal *evacuation trenches* may be greater. They must admit of the passage of litters without difficulty; this is the criterion as to sufficiency of width, and must be insisted upon. This width is made as great as 5 feet for the passage of a column of twos,

and even to a width of 8 feet for the passage of small vehicles, etc. For the decanville railway the width must be 10 feet. If the soil is friable, the slopes are given a greater incline and the berms are made wider.

The trace.—As communicating trenches lead in the general direction of the enemy, they have everything to fear from enfilade fire. For this reason they can scarcely be too deep nor too sinu-

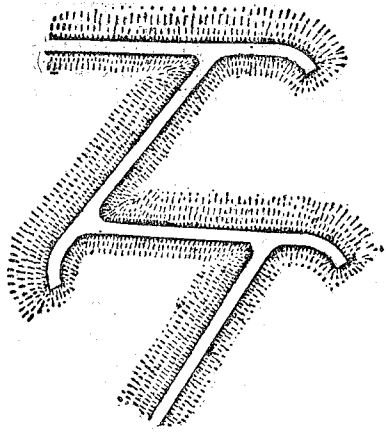


FIG. 229.

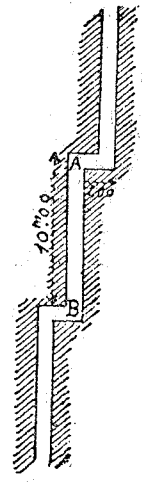


FIG. 230.—Trace with indentations.

ous, especially on slopes turned toward the enemy, when the slope is much inclined and the enemy dominates.

At certain points protection will be secured only by deep, covered saps (fig. 234).; the zigzag trace (fig. 229) guarantees protection against enfilade, but is of considerable length.

When the terrain makes it necessary to run the trench in a straight line, traces are adopted of one of the patterns shown in figures 230 to 233. Movement must be facilitated at the elbows, as shown in figures 235, 236, and 237. For evacuation trenches a trace without traverses is always adopted.

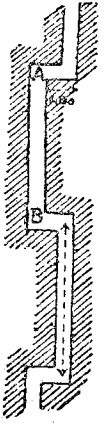


FIG. 231.—Trace with traverses.

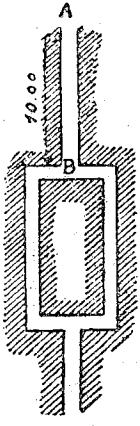


FIG. 232.—Trace with island traverses.

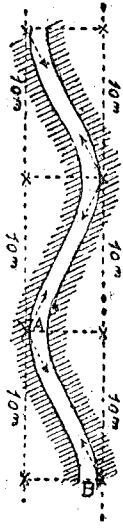


FIG. 233.—Sinuous trace.

Various trench arrangements.—About every 110 yards steps must be constructed for getting out of the trenches and at shorter distances *turnouts* large enough to contain a litter and its two bearers should be arranged. Wide sortie steps should be established at the points where the communicating trenches are to serve as assembly places for a counter attack, as provided

for in the plan of defense. Each communicating trench from its origin to the advanced parallel should be given a distinct

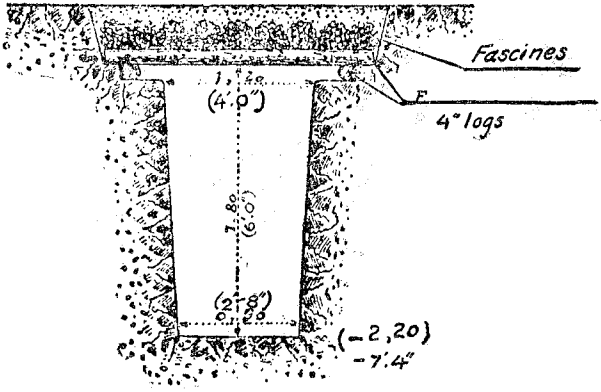


FIG. 234.

name or number. The secondary communicating trenches and the transversals are denominated in a different series from that adopted for the principal communicating trenches.

Arrange crossings in such a fashion that once having entered the approach trench it will guide a man to the advance trench. One method of doing this is to arrange a step into the bottom of the transverse trench where it enters the approach trench. Another way is to wedge a strong stick across the opening of the side trench. Where a transverse trench is crossed ramps from it to a footbridge over it should be constructed, so that if both it and the approach trench are being used at the same time those in the transverse trench may use the ramp and bridge. Mark out the approach and transverse trenches by means of numerous signboards of different shapes, sizes, and colors for principal and secondary approach trenches, for those to be used to go to the front, for those used to go to the rear, and for

transversals. These signboards are absolutely essential at entrances, crossing points, forks, and points of exit. Arrows are

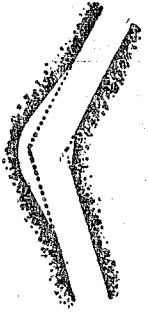


FIG. 235.

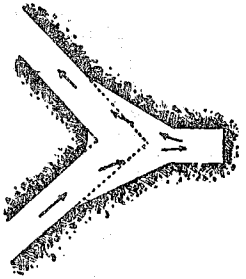


FIG. 236.

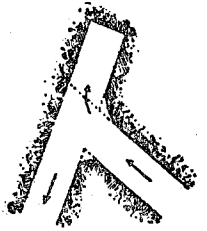


FIG. 237.

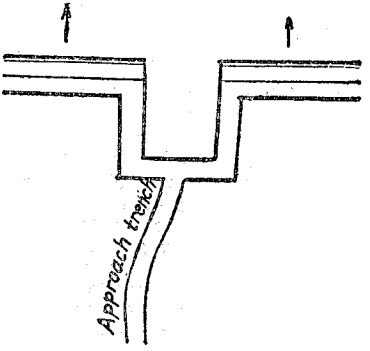


FIG. 238.

also put up to show the direction of authorized movement. In each principal approach trench movement in one sense of the

word is only to the front, except for the agents of liaison, persons authorized specially, etc. A most rigid police discipline must be kept up in the trenches.

The berms permit the men to spring from the trenches and parallels and facilitate the placing in position of footbridges or movable bridges for temporary use. It is always well, by

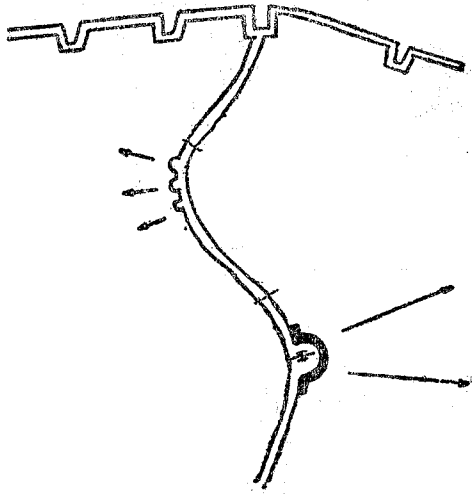


FIG. 239.

providing the necessary footbridges, to have a track or trail alongside of the principal approach trenches, so that at night this open-air route may be used. At the point where the approach trench joins the firing trench there must always be a traverse, as shown in figure 238.

Defensive organization of the approach trenches.—The approach trenches should contribute to the general scheme of stop-

ping at every step an enemy who has gained a footing in the front-line trench. They are, therefore, organized at intervals into firing trenches by making steps or berms from which men

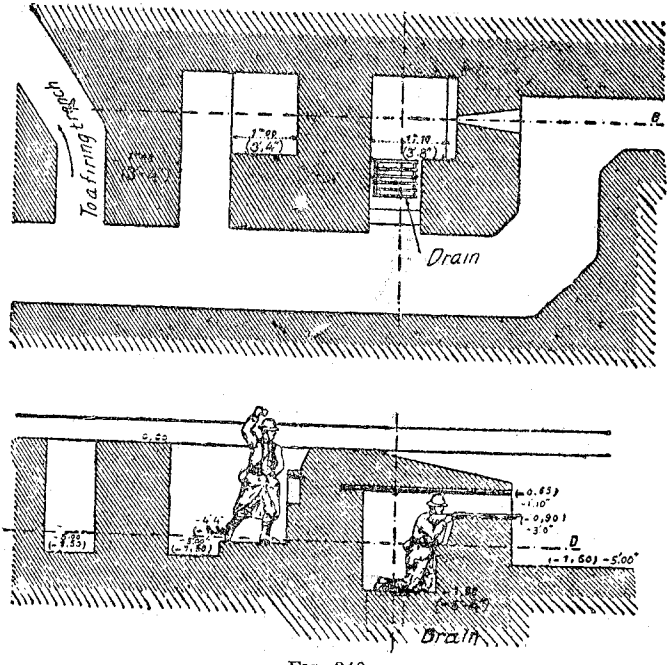


FIG. 240.

may fire, or by building niches in the walls for the firers. By this means they form flanking defenses for all of the terrain between the various parallels. (See fig. 239.) Full use is made of automatic rifles and machine guns in these arrangements.

Their interior, step-by-step defense is organized by the use of barricades, loopholed traverses, platforms for grenadiers, al-

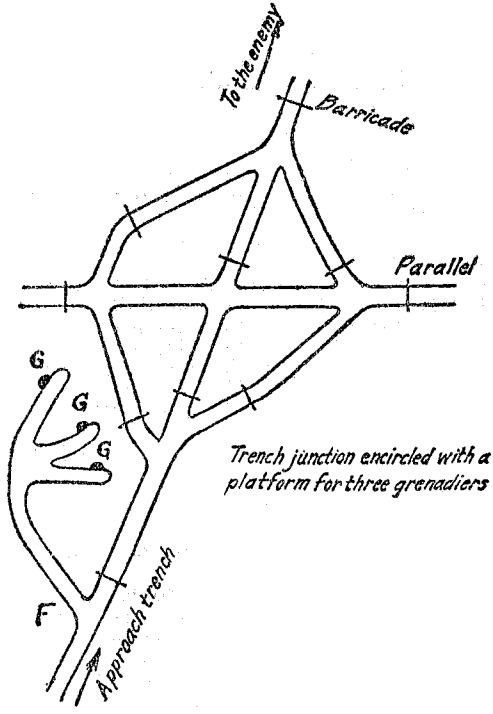


FIG. 241.

lowing of the enfilade of all of the rectilinear parts of the approach trench which are of any considerable length. Figure 240 gives examples of some of these arrangements.

These straight parts of the trench should be 55 yards long and should end by a defensive arrangement, this distance being out of range of the hand grenade, even if the enemy does construct a barricade at the other end of the stretch. Means for obstructing trenches, such as gabions, herissons (wooden frames with barbed wire stretched upon them and having length, breadth, and thickness), etc., are prepared and kept at hand for the very purpose of holding the enemy under fire of these interior flanking defenses. A disposition to be recommended is that shown in figure 241, which consists in encircling a trench junction with a number of other trenches, thus transforming it into a small work which will form one of the active elements of the system of the defense, and the defense of which can be assigned to a squad or half squad. Barricades furnish the means of quickly obstructing a trench in case of attack, and must be carried by the enemy one at a time. Wherever it is desired to dispute the enemy's passage, a double or a triple platform for grenadiers may be prepared, the entrance to which will be defended by the squad. The niches for the grenades are arranged as shown in figure 42, or with a gabion buried horizontally in the slope, the interior being left empty. All of these works for husbanding strength and for defensive organization in the area of a point of support, are to be done by the company which garrisons the point.

SHELTER.

1. BOMBPROOF SHELTER.

Shelter is of value only when it affords complete protection and enables its garrison to leave it in time. The only shelter to consider in the organization of a position is that which is bombproof, and principally cave shelters under 20 feet of undisturbed earth, which have been described in "Trench school," Chapter VIII of Part III. Shelters formed by excavating a hole in soft earth with a roof formed afterwards of earth, supported by logs or rails, are only used in special cases, such as in wet ground, observing stations, shelters for machine guns, etc. They require more materials than cave shelters but do not take as long to construct when the excavation can be made in

the open. They should be made as strong as possible and with small relief. To afford shelter from the 105 (4.2-inch) they should have one layer of steel rails in contact, covered with a yard of earth; one bursting layer (logs in contact, sacks of cement, heavy sheet iron and gravel, broken stone, etc.). The cover against the 150 (6-inch) requires two layers of steel rails separated by 18 inches of earth; two bursting layers separated by ½ to 1 yard of earth. (Or better; 1 layer of steel rails in

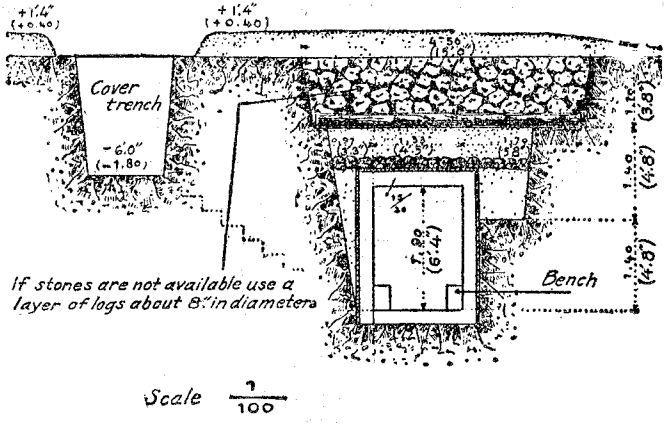


FIG. 241a.

contact covered with 1 yard of concrete.) The bursting layer may consist of 1 or 2 layers of flagstones or reinforced concrete. In general terms 1 yard of solid earth is equivalent to 1 layer of logs, 6 to 8 inches in diameter, covered with 1 yard of soft earth. Fig. 241a is an example of a light bomb-proof shelter. These shelters always cave in after a certain time from the weight of their cover and last a much shorter time than well constructed cave shelters. Whatever their character, shelters should always have *several entrances* (at least

two) on their rear. The precautions against gas should always be insisted upon. (See Chap. XIV, Pt. III.) It is much better to construct a number of small shelters for a squad or section than a few large ones. During the artillery bombardment, the officers should remain in the shelters of their men, and not be together in one shelter. A good disposition consists in excavating two small cave shelters on each side of a traverse, each entrance being at least 2 yards from the traverse; these are connected by a mine gallery 3 feet 4 inches by 3 feet 4 inches, which is enlarged later if time permits, so as to make a single large shelter. (Fig. 242.) Every shelter

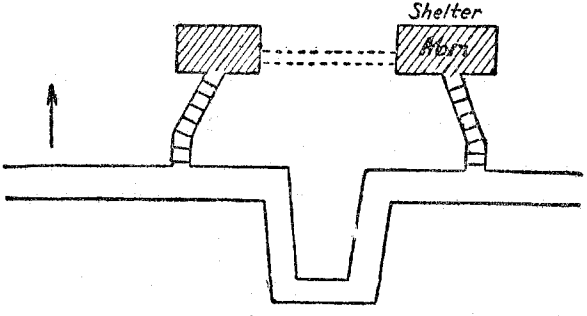


FIG. 242.

should contain a pick and shovel, so that the entrance may be cleared if it is obstructed; some grenades to clear the entrance, so that the garrison may debouch in force if the enemy gets into the trench; arrangements for ventilation, heating, and sleeping; arrangements for observation (large periscope), communication with a lookout, and for the defence of the entrance of the shelter. (See Fig. 277.)

Location of shelters.—Shelters are seldom constructed in the firing trenches, but in the cover trenches, or, if there is no cover trench, in small special lateral tranches, joined by at least two approaches to the firing trench. Others should be in

the support trenches, for the shelter of a section or platoon reserved for counter attacks. Their location is always de-

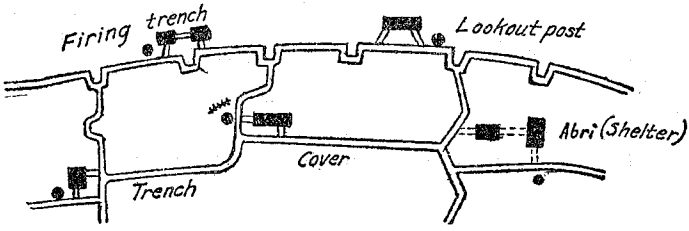


FIG. 243.

pendent upon the location of the lookout posts, for which the most favorable locations must be selected; and the shelter is

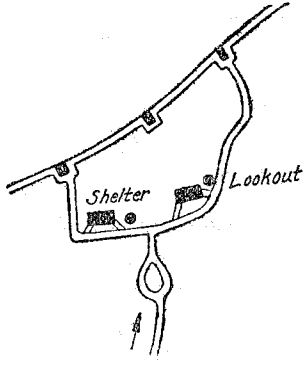


FIG. 244.

constructed in the immediate vicinity of one of these posts. The number of bombproof shelters should be sufficient for all

the garrison (deducting sentinels in observation) to find complete shelter and remain in safety under the most violent hostile artillery bombardment. A company should therefore have six or seven shelters, each for a section, distributed between the cover trench and the support trench.

2. LIGHT SHELTER.

In addition to the bombproof shelters indispensable for the firing line, and which should be provided without delay, it is

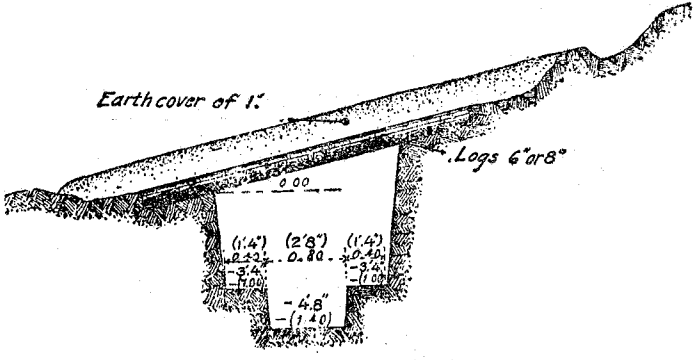


FIG. 245.—Light shelter.

advisable to construct *light shelters* for the other lines and for the reserve positions, which, until better ones can be constructed, will furnish them with *splinter-proof cover* and shelter from the weather. These shelters are constructed either in the trench itself or in rear of it. Figures 245, 246, 247, 248, and 250 indicate the various forms. The time and materials available determine the choice of these types to be adopted. They are temporary expedients of a provisional character, as they deteriorate rapidly under the effects of the weather.

The dangers to be avoided are the weakening of the parapet and the decreasing of the firing crest.

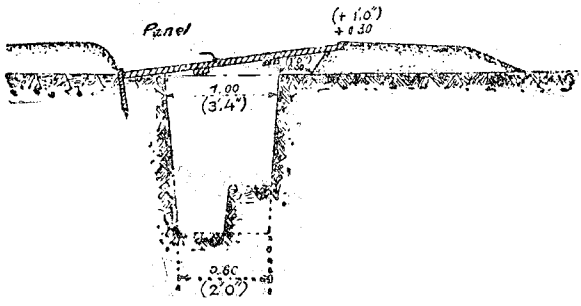


FIG. 246.—Covered trench.

Niches that are not lined with timber should be forbidden in soft or cracked soil.

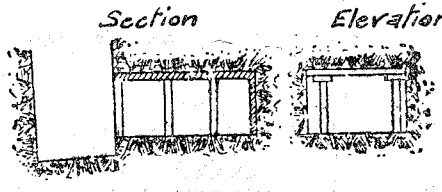


FIG. 247.—Niche for a man with plank roof supported by posts.

The sheds, hatch covers, etc., should not be fixed in place, but should be so arranged that they can be quickly thrown off to enable the men to man the firing crest.

For protection from shell splinters and shrapnel 12 to 20 inches of earth on a roof of light logs or planks should be provided.

3. SHELTERS OF SHEET IRON.

These consist of: (1) Curved sheets of iron, with which shelters like that shown in figure 252 may be constructed in rear

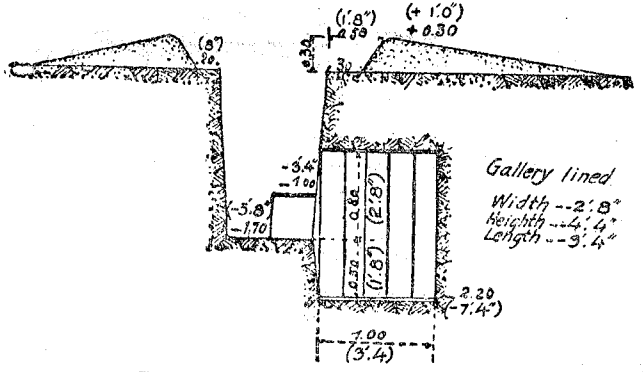


FIG. 248.—Niche for two men sitting.

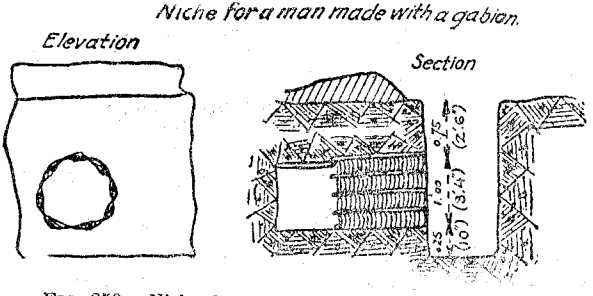


FIG. 250.—Niche for man constructed with a gabion.

of the lines. (2) Elements of light shelters constructed of corrugated iron about 0.04 inch thick, weighing about 22 pounds.

(Fig. 253.) The straps *a* are arranged so that they may be assembled with iron bands. They should be covered with earth.

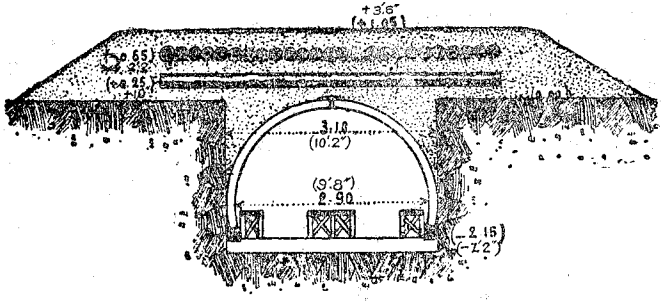


FIG. 252.—Shelter with arched steel plates.

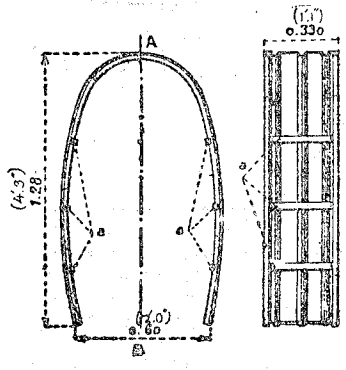


FIG. 253.—Element of a light shelter of corrugated iron.

Shelters may be improvised by means of these devices during an attack.

4. REINFORCED SHELTERS.

The shelters called reinforced should be excluded. There should be no intermediate step between the light shelter and the bombproof shelter. If the construction of bombproof shelters can not be undertaken, it is better to disperse the men in many light shelters than to crowd them in weak shelters, even though they are reinforced. If it is believed that there is time to construct a reinforced shelter, it is better not to do it, but to commence the construction of a cave shelter.

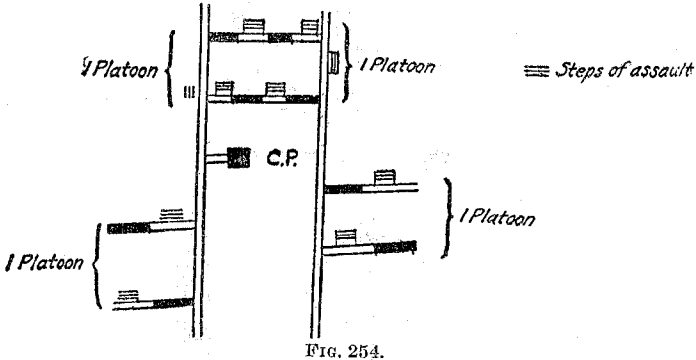


FIG. 254.

Command posts—Telephone stations—First-aid stations—Depots for munitions.—These differ from shelters only in their dimensions and interior arrangements. The location of the *observation station* of a commander should always be made before that of his *command post*, which should be near it. If possible, locate it near a main approach trench; mark its location in several ways (signposts, lanterns, orderlies, etc.) so that it can be found day or night by the liaison agents who are strangers to the unit. The telephone stations should be near the observing station or the command post; *they are supplemented by visual stations, which can be substituted for the former immediately.* Provide each command post with an incendiary grenade

to destroy all papers if it is necessary to evacuate the command post in haste.

The dressing stations and places where wounded are collected should be near an approach trench.

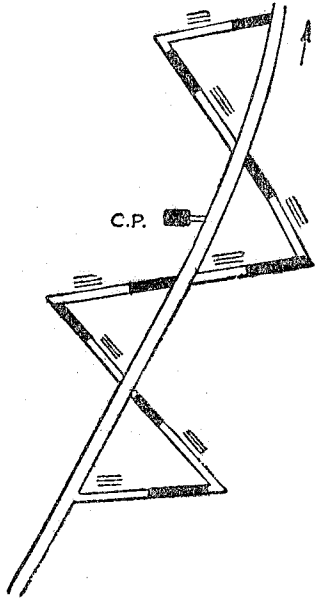


FIG. 255.

Avoid constructing in the approach trenches all works which will cause halts or crowding (distribution of tools, etc.) and therefore interfere with the traffic in them.

Assembly places.—The assembly places are intended to allow the assembly under cover, for a relatively short time, of all the

supports and reserves. They may be established from existing parallels, or be constructed entirely for that purpose by branches from the approach trenches. They may well be located near the reserve trenches, where they can utilize the shelters in these trenches.

They should avoid an excessive division of units; provide easy means of reaching the open ground (steps) and the approach trenches; be provided with shelter (covered trenches, command shelter, etc.), a water supply, and latrines; not attract attention by an appearance different from that of the other trenches.

The choice of the location of the assembly places depends upon the rôle of the troops that are to occupy them. The slowness of the movements confined to the approach trench, the necessity for decreasing the length of the distance to be covered in exposed terrain in order to reach the parallel of departure. These considerations govern the choice of location of assembly places.

LEGEND.

Order of the work.—The plan of the works to be constructed is fixed by the commander. When it is necessary to rapidly organize a position recently captured, the order of importance of the work is as follows: (1) Prepare the works for flank fire; (2) construct the firing trenches; (3) construct at the same time the wire entanglements, the observing stations, the shelters, and the latrines; (4) open communications laterally and to the rear (commence the approaches to the front); (5) complete the trenches.

CHAPTER VII.

OBSERVATIONS AS TO THE TACTICAL CHARACTERISTICS OF THE SEVERAL ARMS AND STAFF DUTY.

ARTILLERY.

Artillery acts exclusively by the power of its fire. Its range permits it to intervene directly not only for the support of troops directly in its front, but also in favor of troops adjacent to it, by oblique and flanking fire (concentration of fire).

Artillery can not drive troops out of a position by fire action alone, but the infantry must take advantage of the effects of artillery fire to advance. These two sister arms, therefore, must be in close and permanent association. To bring about this association is the task of the higher command, of the artilleryist, and of the infantryman.

Classification of artillery.—Artillery is classified as—

A. *Trench artillery*, which throws large quantities of explosives to short distances only. (Mortars of 58, 150, 240, 340 millimeters, i. e., 2.3, 6, 9.6, 13.4 inches.)

B. *Field artillery* (75, 80, and 90 millimeters, i. e., 3, 3.2, and 3.6 inches) which can move at all gaits and over all classes of terrain and which can be placed in battery immediately. The 75-millimeter rifle has a range of about 7,500 yards. Field artillery is employed against the enemy's troops to destroy their auxiliary defenses and to engage all the hostile batteries within its range.

C. *Heavy artillery* (H. A.) which is moved with a certain degree of difficulty, and generally requires preliminary work in placing it in battery before it can open fire. When it has its own motive power (horses or motor tractors) it is called *heavy field artillery;* when it has no means of locomotion it is termed *heavy artillery of position.* The especial value of heavy artillery lies in the superior weight of its projectile and the destructive effects of its impact, the quantity of explosive that it contains, and, for certain pieces, in their extreme range.

The *long pieces*, or *rifles*, on account of their range, are employed against distant objectives (batteries, observing stations, communicating trenches).

The *howitzers* or *mortars*, on account of their curved trajectory, are employed against defiladed objectives (batteries, trenches, wire entanglements on the counterslopes, etc.) and, owing to the smashing power of their projectiles, are able to destroy dugouts, command stations, casemates, etc.

The rifles are of 95, 105, 120, and the 155 mm. caliber (i. e., 3.8, 4, 4.8, and 6.2 inches). The short pieces are the 155 mm. (6.2 inches) howitzer and the 220 (8.8 inches) and 270 mm. (10.8 inches) mortars.

D. *High-power artillery.*—It is composed of motor-drawn pieces, or of pieces which are moved on rails. Its task is the

destruction of objectives which the other classes of artillery, either through lack of range or the inadequacy of their projectiles, can not damage. It therefore has for objectives strongly fortified supporting points, railway stations, centers of communication or supply, aviation parks.

The principal rifles are the 14, 16, 19, 24, 27, and 32 centimeter and the 305 and 340 millimeter (i. e., 5.6, 6.4, 7.6, 9.6, 10.8, 12.2, 12.8, 13.6 inches).

The principal howitzers are the 370 and 400 milimeter (about 14.6 and 15.8 inches).

Projectiles.—Three classes:

Shrapnel, which, at the bursting point, projects the bullets contained by it.

High-explosive shell, containing an explosive which produces its effect by the rupture of the envelope and the blast of its gases.

Special shell.—The projectile may burst on impact (percussion shell) or before impact at some point of its trajectory (time fuse). In both cases the shell is exploded by a fuse.

For the effects of the several classes of projectiles see Chapter XIV, Part III.

Ranging.—To score a hit when the precise range is known, it is not sufficient to take the exact elevation corresponding to the distance. Example: To hit a target at a range of exactly 4,500 yards it is generally necessary to take a slightly different elevation (4,400, 4,475, 4,550, etc.); the reasons for this correction are: Variations of temperature and wind, differences in elevation of the piece as compared to the target (site), slight differences in the quality or weight of powder charge, or in the weight of the projectiles, which are never entirely uniform.

To get the range it is necessary to determine *practically* the elevation which will place the *center of impact* on the target. It is of prime importance to determine the exact elevation. Without it fire is useless; it may even be detrimental.

Observation.—In order to get the range it must be possible to observe the effects of fire. The artillery observer, who is generally an officer, regulates the fire.

The useful effect of artillery fire is proportionate to the extent to which its results can be observed. Artillery can adjust its fire to the advance of the infantry only when it can see or

when it knows precisely the positions occupied by the advance lines of the infantry.

It is important, therefore, that artillery have excellent observation stations; that is to say, points which afford adequate fields of view for the observers, and which can be occupied in spite of the hostile fire. When the infantry needs the support of the artillery, the observer is never, because of danger, justified in quitting his observation station. The observation stations communicate by telephone, signals, messengers, etc., with the batteries of which they control the fire, and with the commander of the infantry which those batteries support.

Dispersion of fire.—It has been shown above that neither the pieces in a battery, nor the charges of powder, nor the projectiles are exactly uniform, and that atmospheric conditions also have an influence upon the accuracy of fire. The shells of a well-aimed fire will not all fall at the same point. This is unavoidable, and the infantry must appreciate this and avoid calling upon its supporting artillery to increase the range of a well-aimed fire simply because some of the shells have fallen short and in the vicinity of the infantry trenches. The infantry which makes premature or unjustifiable complaints to its artillery disturbs the fire of that artillery and diminishes, to the infantry's detriment, the assistance which it affords.

Duty of infantry in connection with artillery.—The infantry must afford to the artillery (*a*) information, (*b*) protection.

Information.—Under normal conditions of trench warfare the results of the service of information performed by the infantry, by which it gathers, collates, and verifies all the information relative to the activities of the hostile artillery and infantry, must be communicated daily to the artillery which supports it. The infantry should keep the artillery informed as to the reliefs of the enemy, their periodicity, hours of marching, their itineraries; likewise complete information as to the enemy's *service of supply*, occupation of the trenches, fatigue details, *hostile observation* stations, machine guns, bomb projectors, etc. It is by keeping the artillery informed as to what he, as an infantryman, knows or sees, that the infantry officer, whatever his rank, obtains to his own advantage, artillery support that is vigilant and well informed, that crushes the enemy by its opportune

entry into the action, and that responds immediately to calls for help.

At the time of an attack.—The infantry officer must appreciate that without his assistance the artillerist is liable to make mistakes, to delay entering into the action or to enter it inopportunely; in short, to render inefficient assistance as a result of which he is sure to suffer. It is therefore the duty of the infantry officer:

(*a*) To inform not only his own chief but also the officer commanding the nearest artillery group as to the position in which his command is located. The best method is by a hasty sketch, traced from his map, with the following note:

"My company is posted from _____ to _____.

"The troops on my right and left are (such) and (such)."

The sketch is authenticated by the sender's signature, and *the hour of signature is given.* The sender insures its speedy transmission.

(*b*) To signal to the artillery the discovery of any good artillery observation stations in the ground that he has just occupied; e. g., "good artillery observation station at (such) point. It commands such and such portions of the ground." If possible, a sketch, with the observation station indicated by a cross, is sent to the artillery commander.

The two rules given above, although applying primarily to the progress of an attack, are likewise applicable to defensive combat when the enemy has succeeded in entering the trenches; the information under such conditions is equally important to the artillery, whose mission is then to stop the enemy as well as to protect the infantry.

Protection.—Under normal conditions the entire system of friendly trenches affords protection to the batteries in front of and around them. During combat, either in attacking a fortified position or in open warfare, the artillery may be called upon to change its position and go into action on ground exposed to the offensive returns of the enemy. The infantry nearest the batteries must supply them with the service of security and information. In certain cases the superior commander assigns a unit as *artillery support.* Moreover, every artillery officer is authorized to ask support from the nearest infantry, and in such a case it must never be refused.

The officer commanding the support communicates with the artillery commander, studies the situation with him, and then makes his own dispositions, for which he alone is responsible. As a rule he places a part of his command sufficiently in advance of the artillery to secure it from hostile infantry fire, and places other fractions, under cover, on the threatened flank.

In every case the infantry must realize that the capture of the guns by the enemy would not only weaken us but would constitute a trophy for him. The abandonment of artillery by the infantry adjoining it is an act of dishonor.

ORGANIZATION OF A FIELD BATTERY.

The light battery of 75's consists of: The combat battery, which can travel at all gaits, and the field train (4 wagons), which can travel only at a walk. The combat battery "in battery" is divided into the firing battery (4 pieces, 6 caissons), the limbers, and the combat train (6 caissons, 1 forge, and 1 battery wagon). The limbers and the combat trains are located behind cover in rear and at distances which vary considerably, depending upon the amount of security required, the probability of having to bring up the limbers, and the requirements as to ammunition supply.

In open warfare these elements may be from 500 to 2,500 yards in rear of the guns. They are protected either by a special support or by a part of the support of the firing battery.

SERVICE OF ARTILLERY.

Artillery is not only an arm, but is likewise a *supply service* which is charged with the supply of ammunition, primers, etc., to all arms, as well as with the replacement of artillery arms and matériel and equipment in general.

CAVALRY.

The cavalry furnishes one regiment to each army corps. The remaining regiments are grouped into cavalry divisions, and these into cavaly corps.

The regiment consists of four squadrons (i. e., troops) of 150 sabers (3 platoons, 4 officers) and machine-gun sections. The noncommissioned officers and troopers are armed with the carbine and bayonet. The dragoons and the light cavalry of the cavalry divisions are armed with the lance. The corps cavalry supplies the divisional cavalry (1 to 2 squadrons).

In addition, the infantry regiments have 12 mounted scouts.

A cavalry division is composed of two brigades of two regiments, a group of horse artillery, a dismounted cavalry regiment, a group of cyclists, and auxiliary elements analogous to those of an infantry division.

Formations.—Line of battle corresponds to the double-rank line of infantry.

Column of twos and column of fours have the same significance as in infantry.

The squadron (i. e., troop) in "column of platoons" is a formation corresponding to the company column of platoons.

The platoon charges in line and as foragers (as skirmishers).

Gaits.—Walk, 110 meters (120 yards) per minute; trot, 240 meters (260 yards) per minute; maneuver gallop, 340 meters (372 yards) per minute; extended gallop, 440 meters (481 yards) per minute. All somewhat faster than prescribed by United States regulations.

Dismounted action.—If the terrain and situation demands it, cavalry fights on foot; 4 men per platoon, designated as horse holders, remain with the horses, each man holding 12 horses. A regiment can thus put 400 carbines in line. In dismounted action each platoon conforms to the rules of combat prescribed for a platoon of infantry.

Duties.—Cavalry is preeminently the arm for surprises. Attached to the infantry, it scouts rapidly and prevents surprises. The *cavalry screen* scouts in advance of the infantry columns outside the limits of infantry reconnaissance, often a day's march in advance of the main body of the army corps. The *divisional cavalry* is assigned to the advance guard of which it constitutes the point, and furnishes patrols to cover the flanks and rear.

The army cavalry (cavalry division) is charged with distant exploration. It remains in concentration in order to be able

to fight, and pushes small detachments (reconnoitering patrols, officers' patrols) boldly to the front.

In addition to its duties in the service of security and information, the cavalry takes part in the battle on the same footing as troops of the other arms. It may fight on an exposed flank, it may exploit a success by a relentless pursuit, or it may sacrifice itself to cover a retreat. It may even undertake the glorious task of sustaining alone the entire shock of battle, thus gaining time for the arrival of the infantry (operations between the battles of the Marne and the Yser). Finally, in trench warfare, it relieves the infantry, and takes its turn in the trenches.

Cavalry is an arm which necessitates a long time for its training, and is costly to maintain. For long periods of time there may be no opportunity for its employment, but, under favorable conditions, it can repay, in a single hour, all that it has cost.

ENGINEERS.

Engineers are closely associated with the infantry. They are assigned to perilous duties; detachments of engineers accompany the waves of assault and share in its dangers.

The infantry, moreover, must never forget that there are strict limitations as to the employment of engineers. In the form which this war has taken there will never be a sufficient number of engineer specialists if they are not reserved for those duties which the infantry is absolutely unable to perform for itself. The infantry, therefore, should not demand labor from the engineers, but guidance; and they must, on the other hand, furnish the engineers with all the assistance they require for mining and other special operations. The engineers must not be broken up into small detachments and dispersed among the infantry units, except in so far as it is necessary to provide overseers. It is better to keep them concentrated and employ them on some well-defined task, to which must be assigned only the exact number of sappers required to complete the work in the required time.

To the engineers is confided the construction, upkeep, and improvement of the lines of communication (roads, railways, pontoon bridges, searchlight sections, military telegraph, carrier pigeons, etc.). By erecting or destroying obstacles and by

constructing certain parts of the intrenchment of supporting points that require especial skill, it participates in combat.

Each army corps contains *corps and divisional engineer companies* (each having its own park); *one company, engineer train* (consisting of wagons loaded with intrenching tools and caissons of explosives), and one *pontoon company.*

The engineer service has also in each army an *army engineer park* and a *telegraphic detachment of the engineer park.*

It supplies engineer equipment and material to all the arms.

AERONAUTICS.

Aeronautical service consists of the aero squadrons of the army corps (reconnaissance, control of fire, bombardments), groups of bombardment squadrons, and balloon companies (balloons and kite balloons).

STAFF SERVICE.

General officers are furnished with a certain number of officers who constitute their staffs.

The staff exercises its functions in the name of the general, of whom it is the assistant. Its duties are—

1. To collect the data upon which the general bases his decisions.

2. To translate these decisions into the form of instructions and orders.

3. In formulating orders and instructions, to go into the necessary matters of detail with which the general should not burden himself.

4. To insure the transmission of instructions and orders, and to supervise their execution.

The chief of staff regulates the work of the staff, directs that of the administrative staff, and in general controls the personnel of headquarters.

Headquarters.—The staff and the other individuals or elements attached to the same superior command constitute its headquarters.

An officer, specially detailed as headquarters commandant, regulates, under the supervision of the chief of staff, the establishment, supply, and protection of headquarters.

CHAPTER VIII.

THE PREPARATION OF ORDERS AND REPORTS.

The characteristics of military style are:

Clarity.—This must be absolute. In composing always put yourself in the place of the man who will read the order. If the least ambiguity is suspected, modify the language and make it precise. Call things by their proper names; choose the exact word. Practical test: Submit what you have written to a comrade who knows nothing as to the subject matter.

Precision.—Spell proper names correctly; give them in full (if necessary in the two languages); underline them; indicate map used; describe the names written in small characters, and especially the hills, by referring them to some prominent point on the map; use the points of the compass instead of right, left, in front, in rear; write important numbers in both letters and figures; avoid inexact expressions such as at dawn or at dark; give the time by the clock, the hours running from 0 to 24.

It must be thoroughly understood that for infantry, as well as for artillery, the *right of an objective* is the part of the objective seen to the right of the person who speaks.

Brevity.—A supplementary quality which must not be sought to the detriment of clarity. Use the abbreviations prescribed in the staff officers' manual, and those only. They are given hereinafter; learn them by heart. In the internal administration of a regiment it is quite possible to save much time and secure greater simplicity by modifying the style customary in peace.

The form.—Bear in mind that the light may be bad at the point where the message will reach the addressee. Write very legibly, in large characters, and use ink or very soft pencil, and punctuate. Protect against rain. State the place, date, and hour of sending, the names of the sender and addressee; however legible the signature is believed to be, always use the following form:

Lieutenant Durand.
(Sig.) A. Durand.

If it can be foreseen that numerous reports must be written under difficult conditions, a message pad, with the above items

entered and signed beforehand, should be prepared. This will reduce writing in the field to a minimum and prevent anything being forgotten. If it seems necessary to keep copies of orders and reports, these should be numbered to simplify reference to a previous order or report, e. g., "Continuing my report No. 4, the machine gun registered . . . . etc."

VARIOUS METHODS OF CORRESPONDENCE.

From a superior to an inferior.—Orders announce to subordinates the decisions of the superior commander. *They are formal directions* applicable to strictly defined conditions of time and space. Only very simple orders of execution, applying to small units, may be given verbally.

From an inferior to a superior.—The *memorandum* is so simple that it should be used in communicating with one's immediate superior, first obtaining his permission.

The *message* is the brief statement of a fact or a situation, written at the *moment of occurrence;* in exceptional cases it may be verbal when it can be made directly by one officer to another without any intermediate agency. Commanders may direct that messages be sent *periodically* (for example, half hourly during combat and twice a day while in the trenches). The sender must be very careful to distinguish between what he has seen himself and reports which he has not been able to verify personally; in the latter case he should always give the source of the information. A message should never contain any speculation as to the unobserved strength of the enemy, or upon his intentions.

The report is the careful, detailed account, written as soon as possible after the events to which it relates. It confirms the information given in a message or it may coordinate that given in several messages. It is invariably written. It must be prepared with care, and if possible on regulation paper, for it may have to be forwarded to the generals. The heading does not indicate the addressee.

REPORT of Lieutenant X. comdg., etc.
Subject (brief of the subject of the report).

The *letter*, on the other hand, is addressed to a superior who is specified.

Lieutenant X, 3d Co., 7th Bn., Alpine Chasseurs.
To: The Colonel commanding the Chasseur brigade.

A brief of the contents is written on the margin, under the heading "Subject."

No formal expressions of courtesy are used. Respect is shown by the tone of the letter. The superior "informs" or "makes known," the subordinate "reports." These shades of expression must be observed.

The *voucher* to indicate receipt is used from superior to inferior and the reverse. It should be signed and returned.

PRESCRIBED ABBREVIATIONS.

Q. G.=Headquarters.
E. M.=Staff.
Inf.=Infantry.
Cav.=Cavalry.
Art.=Artillery.
Gén.=Engineers. } Must not be
Gal.=General. } confused.
C. A.=Army Corps.
D. I.=Infantry division.
D. C.=Cavalry division.
Bde.=Brigade.
Rgt.=Regiment.
Btn.=Battalion.
Gr.=Group.
Col.=Colonel.
Cdt.=Commandant.
Cap.=Captain (not corporal).
Lieut.=Lieutenant.
Sgt.=Sergeant.
H.=Men (privates).
Ch.=Horses.
E. N. E.=Elements not grouped in divisions.
Cie.=Company.
C. M.=M. G. company.
Bie.=Battery.
Pel.=Platoon, cavalry.
Sct.=Platoon, infantry.
A. G.=Advance guard.
Arr. G.=Rear guard.
A. P.=Outpost.
P. C.=Command station.
Cant.=Cantonment.
Biv.=Bivouac.
P. I.=Initial point.
Smi.=Section, infantry ammunition train.
Sma.=Section, artillery ammunition train.
A. C. 9.=Corps artillery, ninth corps.
A. L.=Heavy artillery.
A. D. 53°=Divisional artillery, fifty-third division.
A. T.=Trench artillery.
T. C.=Combat train.
T. R.=Field train.
C. V. A. D.=Supply trains.
C. V. auto.=Motor truck columns.
C. V. A. X.=Auxiliary supply train.
T. M.=Train for transportation of matériel.
Appt.=Supply.
Ravt.=Supply.
P. A.=Artillery park.
S. P.=Section of artillery park.
P. Gen.=Engineer park.
Amb.=Ambulance.
G. B. D.=Detachment of divisional litter bearers.
G. B. C.=Detachment of corps litter bearers.
G. Rav.=Refilling station, rail.
G. O. E.=First station, line of communication.
G. R.=Regulating station.
T. E.=Rail head.
S. M.=Depot station.